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ROYAL ASTRONOMICAL SOCIETY.

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Rev. R. SHEEPSHANKS, V.P., in the Chair.

James Wm. Jeans, Esq., of Grantham, Lincolnshire, and
Peter Legh, Esq., of Norbury Booth's Hall,
were balloted for and duly elected Fellows of the Society.

Lieut. Stratford, R.N., has published an ephemeris of Faye's Comet for the present month of December. The limits are between $21^h\ 30^m$ and $22^h\ 30^m$ right ascension, and 97° and 95° north polar distance from Dec. 1 to Dec. 31.

Attention is called to the total eclipse of the sun of July 28, which will be favourably seen in the north-east of Europe.

DE GASPARIS' NEW PLANET.

Letter to Mr. Hind, from Professor Annibale de Gasparis.

Naples, Nov. 4, 1850.

"I have the honour to inform you that on the evening of November 2, at about $6^h\ 50^m$ P.M., I discovered a new planet. It is somewhat fainter than *Victoria*, and has a rather rapid motion in right ascension. I found it while working at my zones near the ecliptic, the precise object of which is to find new planets.

Approximate places.

1850.	Naples M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″
Nov. 2	7 3 6·5	30 31 49·9	+7 58 55·0
3	7 21 41·4	30 14 58·3	+8 0 18·5

"I have written to M. Leverrier to request him to name the planet, and to assign its symbol. He has selected *Egeria*.

"The symbol of *Hygeia* is a serpent (like a Greek ζ) crowned with a star. That of *Parthenope* is a fish crowned with a star."

ALTONA. (Prof. Schumacher and Dr. Petersen.)

1850.	Altona M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″	
Nov. 13	13 25 45·2	27 34 25·0	+8 19 38·6	10 mag.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1850.	Greenwich M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$
Nov. 16	9 37 11·8	1 47 37·22	−7·845	81 33 11·6	−9·8464
—	9 57 8·2	36·34	−7·545	8·6	9·8471
—	10 17 4·4	35·62	Mer.	5·3	9·8469
Nov. 21	9 50 14·5	1 43 25·02	−6·722	81 18 55·4	9·8450
—	10 5 11·8	34·38	+7·324	53·4	9·8451
—	10 20 9·4	23·94	+7·675	51·4	9·8453
Nov. 23	8 20 8·3	1 41 57·51	−8·160	81 12 44·1	9·8479
—	8 35 5·4	56·95	−8·077	40·7	9·8467
—	8 50 2·6	56·36	−7·973	38·2	−9·8458

The star of comparison for all the observations was *ο Piscium*. The adopted mean place derived from the Greenwich 12-Year Catalogue is as follows:—

	Mean R.A. 1850·0. h m s	Mean N.P.D. 1850·0. ° ′ ″
ο Piscium	1 37 28·68	81 35 57·18

THE NEW PLANET VICTORIA.

Letter from Mr. Hind, Sept. 13, 1850.

"I hasten to announce to you my discovery of another new *planet* this evening, at 10^h 10^m M.T. in *Pegasus*. Rough reductions give,—

1850.	Green. M.T. h m s	R.A. h m s	Decl. ° ′ ″
Sept. 13	10 12 9	23 43 56·65	......
	11 18 50	54·32	+13 49 45·2
	11 41 38	23 43 53·20	+13 49 34·2

"The first observation of declination *doubtful*. The planet is a full 9th magnitude, and to my eye somewhat blueish.

"*September* 16.

"By a very vexatious mistake in using the wrong comparison star, my places of the planet were thrown wrong. The following are the corrected observations:—

	Green. M.T. h m s	R.A. h m s	Decl. ° ′ ″
Sept. 13	11 29 36	23 44 45·08	+14 6 42·9
14	8 28 24	23 44 2·56	+13 59 29·3

"It is fully as bright as stars of the 8th mag. I have called the new planet *Victoria*, for which I have devised, as a symbol, a star and laurel branch, emblematic of the Goddess of Victory."

The above extracts are taken from Mr. Hind's letters, written at the time. The following more particular account has since been received:—

"About ten o'clock on the evening of the 13th of September I discovered a new planet in the constellation *Pegasus*. I was

occupied, at the time, in a close comparison of a chart for Hour xxiii. with the heavens, re-examining the small stars inserted in previous years, to ensure their being placed in the right position upon the map, and to ascertain if any change of magnitude, &c. had taken place; for it has always appeared to me very desirable that every variable star should be duly specified in forming a chart. Near one of the tenth magnitude, entered in 1848, I found another brighter object, which was at once suspected to be a planet, as it could hardly have escaped my previous sweeps over the vicinity. At $21^h\,41^m$ sidereal time at Mr. Bishop's observatory, it preceded my star of the tenth magnitude $14^s{\cdot}45$, while, on repeating the transits over the vertical wire of the micrometer at $22^h\,30^m$, the difference of right ascension was $16^s{\cdot}30$; and the motion thus indicated was confirmed by observations continued till $23^h\,15^m$, when the interval between the transits was $17^s{\cdot}95$. No doubt, therefore, could exist as to the planetary nature of the stranger; and its position in the solar system was clearly shown by the amount and direction of the diurnal motion. The Astronomer Royal has kindly determined the accurate position of the small star, which I compared with the planet, and has given me the following results, depending upon five transit observations and four observations with the mural circle :—

Mean R.A. 1850,	$23^h\,44^m\,59^s{\cdot}64$	Mean N.P.D.	$75°\,41'\,44''{\cdot}85$
App. R.A. Sept. 13,	23 45 2·39	App. N.P.D.	75 41 28·2

The micrometric comparisons give the following position of the planet :—

1850.	Greenwich M.T. h m s	R.A. h m s	N.P.D. ° ′ ″
Sept. 13	11 29 36	23 44 45·19	75 53 17·1

Observations.

Altona. (Prof. Schumacher and Dr. Petersen.)

1850.	Altona M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″	
Sept. 25	11 35 41	353 46 14	+12 10 55·2	Eq.
30	10 54 19·7	352 52 38·3	11 16 48·8	Mer.
Oct. 2	45 9·9	352 33 5·9	10 54 39·4	—
6	27 7·2	351 58 11·9	10 10 15·2	—
7	22 40·1	50 24·0	9 59 17·1	—
8	18 14·9	43 3·5	9 48 18·5	—
9	10 13 51·3	351 36 6·6	+ 9 37 25·4	—

Berlin. (Prof. Encke and Dr. Galle.)

	Berlin M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″	
Sept. 20	9 11 53·6	354 46 37·2	+13 3 56·4	Equat.
	11 41 9·6	45 17·7	2 49·6	Merid.
21	9 47 18·0	354 34 14·8	12 53 33·7	Equat.
	11 36 25·5	33 11·3	52 50·8	Merid.
27	11 8 15·0	353 24 13·8	+11 49 46·1	Merid.
	11 22 40·0	24 13·6	49 39·8	Equat.

BRESLAU. (Prof. von Boguslawski.)

1850.	Green. M.T. h m s	R.A. h m s	Decl. ° ′ ″	
Sept. 29	8 27 49·9	23 32 15·19	+11 28 46·0	Diff[l]. Microm.

HAMBURG. (M. Rümker.)

1850.	Hamburg M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″	
Sept. 20	10 16 50·6	354 45 18·0	+13 3 4·4	
25	8 23 15·8	353 47 45·3	12 12 25·8	
	11 17 37·9	......	11 11·0	Mer. Circ.
26	8 39 5·4	353 36 18·3	12 1 43·6	
	11 12 52·4	35 4·8	0 35·2	Mer. Circ.
28	8 38 3·0	353 14 30·5	11 39 52·3	
29	8 3 26·0	353 4 12·2	11 29 14·3	
30	9 54 35·7	352 53 3·8	11 17 13·8	
	10 54 20·4	52 38·1	16 46·3	Mer. Circ.
Oct. 1	7 32 35·5	352 44 7·5	11 7 21·3	
2	8 7 20·0	352 34 8·7	10 56 1·9	
	10 45 10·0	......	54 38·5	Mer. Circ.
6	7 42 49·1	351 59 7·0	10 11 35·7	
	10 27 7·0	58 15·0	10 16·4	Mer. Circ.
7	8 34 29·0	351 51 2·5	10 0 9·7	
	10 22 39·8	50 23·3	9 59 16·8	Mer. Circ.
8	8 37 14·0	351 43 48·8	9 49 12·6	
	10 18 14·6	43 3·2	48 17·5	Mer. Circ.
9	8 10 8·8	351 36 45·9	9 38 30·5	
	10 13 50·8	36 3·5	37 24·6	Mer. Circ.
10	7 19 4·0	351 30 22·8	9 27 55·4	
	10 9 28·5	29 26·0	26 46·3	Mer. Circ.
12	7 33 27·2	351 18 26·8	9 6 21·2	
13	7 10 38·1	351 13 5·0	8 56 8·2	
21	10 32 0·4	350 46 56·2	7 36 6·2	
31	10 47 20·0	350 56 56·4	+ 6 15 46·0	

With the Transit Instrument. (M. G. Rümker.)

	Hamburg M.T. h m s	App. R.A. ° ′ ″		Hamburg M.T. h m s	App. R.A. ° ′ ″
Sept. 26	11 12 52	353 35 5·0	Oct. 7	10 22 40	351 50 21·3
Oct. 2	10 45 10	352 33 9·2	9	13 51	36 4·5
6	10 27 7	351 58 14·0	10	10 9 28	351 29 25·8

MARKREE. On the Meridian.

	Green. M.T. h m s	R.A. h m s	Decl. ° ′ ″	
Sept. 17	12 22 55	23 41 24·62	+13 31 5·4	+[0·7444] ÷ Δ.

HAVERHILL. (Mr. W. W. Boreham.)

	Green. M.T. h m s	R.A. h m s	N.P.D. ° ′ ″
Oct. 1	11 20 25	23 30 48·87 +0·056 P	78 54 50·3 +0·657 P

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1850.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$.	Star of Comp. B.A.C.
Sept. 17	11 52 12·1	23 41 26·03	−7·4279	76 28 36·9	−9·8045	8182—8370
	12 47 0·8	24·02	+7·8520	28 57·8	·8060	— —
21	10 0 31·2	38 14·14	−8·2683	77 6 50·3	·8197	8182
	10 50 22·1	12·78	−8·0098	7 12·5	·8129	—
26	9 33 1·0	34 22·67	−8·2814	77 59 3·7	·8274	—
	9 52 57·5	21·79	−8·2026	59 10·9	·8239	—
	10 12 53·8	21·06	−8·0997	59 20·1	·7950	—
28	10 9 34·4	32 53·97	−8·0626	78 21 3·8	·8342	—
	10 29 30·4	53·24	−7·9088	21 16·4	·8225	—
	10 49 26·8	52·61	−7·6630	21 25·6	·8215	—
Oct. 1	12 17 17·3	30 47·15	+8·1210	78 55 13·7	·8298	—
	12 37 13·8	46·91	+8·2177	55 22·8	·8322	—
4	10 27 56·9	28 59·10	−7·5478	79 27 48·4	·8305	—
	10 47 53·3	58·78	Mer.	27 57·9	·8304	—
5	8 55 42·5	28 27·17	−8·2643	79 38 13·9	·8391	—
	9 15 39·0	26·78	−8·1808	38 19·9	·8328	—
11	7 47 22·7	25 35·48	−8·3903	80 43 19·4	·8527	8250
	8 7 19·4	35·11	−8·3361	43 28·0	·8498	—
	8 27 15·8	34·94	−8·2703	43 36·1	·8471	—
21	11 24 55·2	23 7·16	+8·2684	82 24 24·4	·8586	8078
	11 54 50·6	6·91	+8·3625	24 34·4	·8619	—
	12 26 45·9	6·66	+8·4377	24 47·7	·8660	—
23	8 37 21·9	23 1·20	−7·9391	82 41 12·1	·8564	8233
	57 18·8	1·11	−7·7194	41 19·3	·8557	—
26	8 51 34·6	23 4·49	−7·5639	83 6 27·4	·8586	—
	9 11 31·9	4·66	−6·8443	6 34·6	·8584	—
Nov. 2	7 21 24·5	24 16·07	−8·1761	83 56 55·2	·8671	—
	7 41 21·6	16·20	−8·0685	57 0·5	·8660	—
8	7 39 53·3	26 27·03	−7·9200	84 31 26·2	·8691	—
	7 59 50·7	27·54	−7·6879	31 28·7	·8680	—
12	8 6 4·4	23 28 28·30	−7·1448	84 49 34·0	·8705	—
	22 2·1	28·70	+7·1448	49 38·2	·8705	—
	8 38 0·3	28·98	+7·6212	49 39·1	−9·8706	8233

"The observations are corrected for refraction. The corrections to be applied for parallax in time and arc are represented by p and q. P is the equatoreal horizontal parallax.

Assumed Mean Places of Stars of Comparison, 1850·0.

	R.A. h m s	N.P.D. ° ′ ″	Authority.
B.A.C. 8078	23 4 9·78	82 5 36·3	Edinburgh Observations.
— 8182	21 34·28	78 3 57·9	— —
— 8233	32 14·40	85 11 10·7	Greenwich 12-year Catalogue.
— 8250	35 44·44	80 30 3·3	Edinburgh Observations.
— 8370	23 58 0·26	77 26 17·4	— —

Durham. Fraunhofer Equatoreal. (Mr. R. C. Carringto

1850.	Greenwich M.T. h m s	App. R.A. h m s	s	App. N.P.D. ° ′ ″	″	No. of Comps. in R.A.	N.P.D.	S
Sept. 16	15 34 39·4	23 42 7·61	+0·031 *p*	76 20 54·9	−0·707 *p*	18	6	(
17	12 10 55·5	41 25·18	+0·002 *p*	76 28 48·7	0·656 *p*	15	5	(
26	9 23 4·5	34 23·25	−0·019 *p*	77 58 57·7	0·690 *p*	10	10	(
	10 24 41·4	21·18	−0·009 *p*	59 24·4	0·679 *p*	11	4	(
28	9 51 26·9	32 54·51	−0·013 *p*	78 20 54·6	0·686 *p*	15	5	(
30	8 59 38·2	31 32·98	−0·020 *p*	78 42 36·7	0·700 *p*	16	8	(
Oct. 1	10 25 57·0	30 50·34	−0·005 *p*	78 54 24·7	0·688 *p*	14	5	(
5	8 24 44·1	28 27·75	−0·021 *p*	79 38 2·7	0·713 *p*	24	8	(
8	10 3 32·9	26 51·57	−0·004 *p*	80 11 53·2	0·703 *p*	15	5	(
9	8 11 21·6	26 25·94	−0·021 *p*	80 21 41·0	0·720 *p*	15	5	(1
11	10 52 19·1	25 32·14	+0·007 *p*	80 44 45·6	0·713 *p*	8	8	(1
14	8 45 18·4	24 31·22	−0·012 *p*	81 15 15·2	0·721 *p*	24	8	(
	11 33 59·4	28·93	+0·016 *p*	16 26·4	0·724 *p*	24	8	(
23	10 52 38·3	23 0·20	+0·015 *p*	82 41 58·8	0·739 *p*	8	8	(
	11 51 52·6	0·79	+0·024 *p*	42 21·7	0·748 *p*	12	4	(
26	13 26 56·8	23 5·45	+0·035 *p*	83 7 57·0	0·778 *p*	18	6	(1
28	8 5 13·3	23 15·51	−0·009 *p*	83 21 53·5	0·743 *p*	15	5	(
29	8 5 54·9	23 23·83	−0·009 *p*	83 29 26·3	0·744 *p*	24	8	(
30	7 57 15·9	23 23 33·89	−0·009 *p*	83 36 40·4	−0·746 *p*	24	8	(

p = Equatoreal Horizontal Parallax in *arc.*

Assumed Apparent Places of Stars of Comparison.

Name.	R.A. h m s	N.P.D. ° ′ ″	Set.
Anonymous, 10th Magnitude	23 46 57·94	76 13 49·8	(1)
Anonymous, the same star,	46 57·95	76 13 49·7	(2)
Weisse 23^h, 712	34 27·03	78 4 54·0	(3)
— 630	30 28·97	77 56 39·9	(4)
— 568	27 38·29	78 9 32·0	(5)
— 647	31 20·23	78 37 47·2	(6)
— 656	31 46·25	79 3 2·1	(7)
— 605	29 24·17	79 48 35·3	(8)
— 596	28 40·25	80 19 4·5	(9)
B.A.C. 8250	35 47·25	80 29 46·0	(10)
Anonymous, 10th Magnitude	25 51·30	80 47 17·0	(11)
Anonymous, 7·8th Magnitude	23 21·38	81 20 14·5	(12)
B.A.C. 8234	32 19·45	81 8 51·3	(13)
Weisse 23^h, 469	23 19·75	82 49 26·0	(14)
— 395	19 44·33	82 45 13·3	(15)
— 452	22 20·76	83 0 3·3	(16)
— 710	34 20·94	83 34 25·7	(17)
— 524	24 37·71	83 44 5·8	(18)
— 524	23 24 37·70	83 44 5·8	(19)

The star of Sept. 16 and 17 depends on approximate equatoreal comparisons only, and requires re-observation. It has a companion of the same magnitude, north preceding.

Oct. 9. Sky very unsettled.

Oct. 11. Star's place only approximate, derived from single comparisons with B.A.C. 8250 and Weisse 23^h, 477.

Oct. 14. Set 12. Star's place is derived from the mean of a satisfactory equatoreal comparison with B.A.C. 8234 and one meridian observation, it ought to be pretty accurate.

Oct. 26. The sky did not clear till midnight, but was very clear afterwards.

Oct. 29 and 30. There is an error in Weisse's catalogue here. No. 524 is 1^m in excess in R.A., and the precessions accordingly slightly in error. Making these alterations, I find by one meridian observation that the assumed apparent place is perfectly correct.

Oct. 30. The observed differences in R.A. were rather irregular: the sky was full of vapour, and the planet at times very dim.

NAPLES. Equatoreal. (Sig. Annibale de Gasparis.)

1850.	Naples M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″
Sept. 24	7 59 13·3	354 0 18·1	+12 23 47·8
26	8 7 24·4	353 37 20·6	12 2 20·8
27	8 52 46·6	353 25 52·8	+11 51 5·7

HARTWELL. Equatoreal. (Professor C. P. Smyth.)

1850.	Hartwell Sid. T. h m	R.A. Planet—Star. s	Obs.	Dec. Planet—Star. ′ ″	Obs.	Star.
Oct. 5	2 50	+ 5·0	6	0 0·0		*a*
8	2 8	+38·0 ±·07	3			
	2 0			−2 56·1 ±0″·8	3	*b*
	2 8	+ 1·3 ±·03	3			
	2 0			−4 19·0 ±0 ·7	3	*c*

The planet appeared as a star of the 9th magnitude.

Approximate Places of Stars of Comparison.

		h m s	° ′
a	10 mag.	α = 23 28 13	δ +10 21
b	9 —	23 25 55	9 52
c	9 —	23 26 32	+ 9 53

Elements.

I. By Mr. G. Rümker, of Hamburg.

Epoch 1850, Sept. 13^d·0, Greenwich Meridian.

	° ′ ″	
M	35 45 24·7	
ϖ	301 42 56·6	Mean Eq. 1850·0.
☊	235 32 52·6	Mean Eq. 1850·0.
i	8 22 45·5	
φ	12 39 8·5	
Log *a* ...	0·3683999	
e	0·2190350	
Log μ ...	2·9974067	μ = 994″·046

The above depend on the first observation of the planet in London, Sept. 13, and the Hamburg observations of Sept. 30 and Oct. 13.

II. By Mr. Fearnley, of Christiania (now at Bonn). Founded on the London observations, Sept. 14, and those at Bonn, by Professor Argelander, on Sept. 26 and Oct. 7.

Epoch 1851, Jan. 0·0, Berlin Meridian.

M	65° 51′ 36″·06	
ϖ	301 43 48·55	Mean Eq. 1851, Jan. 0.
☊	235 48 45·21	
i	8 19 29·05	
ϕ	12 42 55·23	
Log. a	0·3672814	

III. *Elements of the Orbit of Victoria*, by Mr. H. Breen, of the Royal Observatory, Greenwich, *deduced from Mr. Hind's Observations of Sept.* 14, *the Mean of the Greenwich and Cambridge Meridian Observations of Sept.* 25, *and the Mean of the Greenwich and Altona Meridian Observations of Oct.* 7.

The observations have been corrected for parallax and aberration.

Mean Anomaly, Sept. 14^d·347373, Greenwich Mean Time		36° 18′ 40″·6
From Mean Equinox, Jan. 1	Longitude of Perihelion ...	301 14 59·5
	Longitude of Node	235 37 23·7
Inclination		8 22 5·9
Angle of Excentricity		12 46 5·6
Log. e		9·3444073
Log. Semi-axis Major		0·3684648
Mean Daily Motion		993″·8240

For the middle observation, these elements are in error,

−0″·4 in Longitude.
+0·3 in Latitude.

IV. *Elements of the Orbit of Victoria*, by M. Yvon Villarceau, *deduced from eleven Meridional Observations made at the Observatory of Paris, from* 1850 *September* 17, *to October* 29. (*In a Letter to the Astronomer Royal.*)

Mean Anomaly, 1850, October 0·0, Paris Mean Time	....	40° 22′ 15″·1
Reckoned from the Mean Equinox, October 0.	Longitude of perihelion.........	301 56 31·9
	Longitude of ascending node...	235 28 25·3
Inclination		8 23 15·3
Angle (sin = excentricity)		12 35 13·2
Semimajor axis (log = 0·3682639)		2·334877
From which		
Duration of the Sidereal Revolution		3^{yrs}·567767
Mean Diurnal Heliocentric Motion		994″·5135
Excentricity		0·2179220

"These elements have been computed by the process of correction of elements which I have pointed out in Nos. 15, 31, 32, and 33, of my memoir on the deter-

mination of the orbits of planets. I ought only to say that the rapid motion of the planet in latitude has allowed me to apply the formula intended for comets, that is to say, those which require only the differences of the second order inclusively."

PARTHENOPE.

CAMBRIDGE, U.S. (Professor Bond.)

1850.	Cambridge M.T. h m s	R.A. h m s	Dec. ° ′ ″
Aug. 26	9 12 40	15 33 0·45	−15 43 51·9
27	7 48 5	15 34 14·45	−15 50 21·9

Reckoned from the mean equinox of 1850, and not corrected for parallax. The planet now appears as a star of the 11th magnitude.

FLORA.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1850.	Greenwich M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	Compd—Obsd R.A. s	Compd—Obsd N.P.D. ″	Star of Comp. B.A.C.
Sept. 21	12 2 39·3	0 24 40·67	100 1 46·5	+2·81	−20·2	62
28	11 23 8·9	18 40·18	100 53 44·2	2·69	16·9	—
Oct. 1	11 36 39·8	16 2·61	101 13 0·0	2·71	17·9	—
4	11 26 17·3	13 28·62	29 43·9	2·85	14·3	233
5	9 59 46·1	12 41·16	34 31·4	2·80	15·7	200—233
11	9 54 25·7	0 7 58·44	101 58 19·2	+2·68	−14·0	8361

"The observed places are corrected for refraction and parallax.

"The parallax and computed places were deduced from the ephemeris contained in the supplement to the *Nautical Almanac* for 1853.

Assumed Mean Places of Stars of Comparison, 1850·0.

	R.A. h m s	N.P.D. ° ′ ″	Authority.
B.A.C. 62	0 11 47·00	99 39 20·8	Greenw. and Edinburgh Obs.
— 200	0 36 37·45	101 25 37·1	B.A.C.
— 233	0 42 36·89	101 27 10·3	B.A.C
— 8361	23 56 49·29	101 20 39·1	Edinburgh Observations.

DURHAM. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1850.	Greenwich M.T. h m s	R.A. h m s	Exc. of Eph. s	N.P.D. ° ′ ″	Exc. of Eph. ″	No. Comps. R.A.	No. Comps. N.P.D.	Set.
Sept. 30	11 32 57·5	0 16 54·70	+2·93	101 6 47·5	−15·1	3	1	(1)
Oct. 8	11 31 23·6	0 10 12·19	2·82	101 48 4·7	13·7	24	8	(2)
9	12 39 25·6	0 9 23·25	2·83	101 52 2·7	13·6	15	5	(3)
14	14 8 11·4	0 5 45·27	+3·34	102 6 7·1	− 9·8	16	8	(4)
28	11 4 14·0	23 59 26·75		102 0 55·8		24	8	(5)
29	9 56 57·4	23 59 14·42		101 58 19·8		16	8	(6)

The data for parallax and the computed places taken from the supplement to *Nautical Almanac* for 1853.

Assumed Apparent Places of Stars of Comparison.

Name.	R.A.	N.P.D.	Stars of Set.
	h m s	° ′ ″	
Weisse 0^h, 387	0 23 26·57	100 54 30·7	(1)
— — 189	0 11 11·91	101 46 35·5	(2)
— — 189	0 11 11·92	101 46 35·6	(3)
— — 102	0 6 23·22	102 7 55·9	(4)
— 23^h, 1242	0 0 10·84	101 57 37·6	(5)
— 23^h, 1227	23 59 45·69	101 51 55·0	(6)

Sept. 30. A single set.
Oct. 2. Very favourably observed.
Oct. 14. Planet getting low.
Oct. 28. Planet still considered a good 8·9th magnitude.

NEPTUNE.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1850.	Greenwich M.T.	R.A.	N.P.D.	Comp[d]—Obs[d]. R.A.	Comp[d]—Obs[d]. N.P.D.	Star of Comp. B.A.C.
	h m s	h m s	° ′ ″	s	″	
Aug. 21	12 31 49·4	22 31 42·33	100 6 54·2	+0·30	−1·1	7897
24	10 55 7·3	31 24·33	8 43·0	0·22	1·6	—
26	10 8 56·8	31 12·06	9 54·5	0·32	0·2	—
Sept. 4	11 42 18·2	30 15·94	15 28·7	0·21	0·3	7840
5	11 35 47·6	22 30 9·85	100 16 6·6	+0·17	−1·7	—

The observed places are corrected for refraction and parallax.

The computed places were deduced from Mr. Sears C. Walker's ephemeris, published in the *Astronomische Nachrichten*, No. 721.

Assumed Mean Places of Stars of Comparison, 1850·0.

	R.A.	N.P.D.	Authority.
	h m s	° ′ ″	
B.A.C. 7897	22 32 12·76	100 8 28·5	Greenw. and Edinburgh Obs.
7840	22 22 42·20	101 26 37·2	Greenwich 12-year Catalogue

DURHAM. Fraunhofer Equatoreal. (R. C. Carring

1850.	Greenwich M.T.	App. R.A.	Exc. of Eph.	App. N.P.D.	Exc. of Eph.	No. of Comps. in R.A.	No. of Comps. in N.P.D.
	h m s	h m s	s	° ′ ″	″		
Sept. 11	9 55 31·4	22 29 33·92	−0·03	100 19 40·2	−2·7	15	5
12	10 30 10·1	29 27·77	−0·04	20 15·1	1·5	18	6
24	9 19 46·6	28 19·11	+0·22	26 54·3	2·2	3	1
28	12 29 4·4	27 57·71	−0·22	28 59·3	1·2	18	6
Oct. 9	11 17 12·2	22 27 5·67	−0·01	100 33 54·8	−0·5	18	6
	11 58 38·1	27 5·49	+0·05	33 54·8	+0·1	12	4

Assumed Apparent Places of Stars of Comparison.

Name.		R.A. h m s	N.P.D. ° ′ ″	Set.
B.A.C.	7861	22 26 14·92	100 22 32·3	(1)
—	—	14·92	32·3	(2)
—	—	14·88	32·6	(3)
—	—	14·87	32·7	(4)
—	—	14·97	33·2	(5)
—	7890	22 31 24·81	100 48 5·7	(6)

The mean places of the stars are taken from the B.A.C. The near agreement of the two observations on Oct. 9 speaks well both for the catalogue and for the method of observing.

Set 3. A single observation, taken in a bad sky.

Set 4. Wind annoying. If the first of the six measures be rejected, as discordant from the rest, the remaining five give $-0^{s}·09$ as the excess of the Eph. in R.A., which is probably nearer the truth. The parallaxes and computed places have been taken from Walker's Ephemeris, published in the *Astron. Nachrichten*, No. 721.

On Lamont's Observations of Neptune, as a Fixed Star. By Mr. Hind.

"In the *Monthly Notice* of the Astronomical Society for January 1850, it is mentioned that I had detected two observations of *Neptune* by Dr. Lamont, at Munich, in the course of his zones; the first in October 1845, and the second on September 7th, 1846. I do not know how I could have overlooked a third observation on the 11th of the same month, when the planet passed the second wire of the telescope at $21^{h}\ 54^{m}\ 0^{s}·9$, and was considered of the ninth magnitude. A notice of this additional observation may not prove uninteresting, as it shows that an *immediate reduction* of the zones of Sept. 7th and 11th could not have failed to point out the planet; and the discovery might have been effected prior to the 23d of September, when it was recognised by Dr. Galle."

METIS.

Markree. (E. J. Cooper, Esq., and Mr. Graham.)

1850.	Greenwich M.T. h m s	R.A. h m s	Decl. ° ′ ″
Sept. 6	15 46 12·7	7 34 3·57	+23 19 51·1

Corrected for parallax.

Extract of a Letter from Mr. Graham.

"I have stolen some hours from our regular work to prepare an ephemeris of *Metis* for the coming opposition. The preliminary and most important step of getting a more correct set of elements is now completed. I arranged, for this purpose, 74 meridional and 69 extra-meridional observations, made at various observatories at the *most favourable time* near the opposition of 1848; 28 meridional

observations made in 1849 at Hamburg, Kremsmünster, and Markree; and one extra-meridional observation made at Markree, 1850, Oct. 21. This last, though taken with great care, is uncertain, from the strong moonlight; but it is the best I could obtain. The elements, corrected for the perturbations by the *Earth*, *Mars*, *Jupiter*, and *Saturn*, and reduced to the mean equinox of the epoch, are for the instantaneous ellipse:—

1850, Nov. 26·0, G.M.T.

M	35° 50′ 6″·88
$\pi - \Omega$	2 17 54·85
Ω	68 29 42·75
i	5 35 42·04
φ	7 1 29·02
μ''	962″·13641

"It only remains to carry up the perturbations to the time of the opposition, and prepare the ephemeris, which I hope to be able to furnish you with a copy of in a few weeks."

BOND'S COMET.

Mr. G. P. Bond, Assistant at the Observatory of Cambridge, United States, discovered a telescopic comet on the 29th of August last. It was found independently by Mr. Brorsen at Senftenburg, in Bavaria, on the 5th of September; by M. Mauvais at Paris, and Mr. Robertson at Markree, on the 9th; and by Dr. Clausen at the Observatory of Dorpat, on the 14th. Mr. G. P. Bond has detected seven or eight comets, but the present is the first which bears his name, as in every other instance a prior discovery was recognised. The comet was observed by the American astronomers till the end of last month.

Observations.

CAMBRIDGE, U.S. (Professor Bond.)

1850.	Cambridge M.T. h m s	R.A. 1850·0. h m s	Dec. 1850. ° ′ ″	Star of Comp.
Aug. 29	11 9 45	3 24 49·67	+58 0 37·9	*a*
30	9 44 43	3 35 45·69	58 7 19·2	*b*
31	8 23 19	3 47 20·86	58 10 17·1	*c*
Sept. 2	10 0 38	4 14 43·20	58 1 24·0	*d*
3	10 17 38	4 29 4·09	57 47 39·3	*e*
8	13 28 0	5 48 22·23	54 24 47·2	*f*
	14 33 0	49 5·06	21 52·6	*g*
10	12 46 38	6 19 31·45	51 53 11·0	*h*
11	10 57 2	6 33 46·17	50 26 31·7	*i*
13	12 28 12	7 4 21·97	46 36 30·2	*k*

1850.	Cambridge M.T. h m s	R.A. 1850·0. h m s	Dec. 1850. ° ′ ″	Star of Comp.
Sept. 20	15 57 40	8 30 58·71	+28 20 20·9	*l*
21	16 38 4	8 40 44·41	25 24 55·1	*m*
Oct. 1	16 47 48	9 54 9·03	+ 0 36 44·1	*n*
Oct. 28	17 40 11	12 1 41·35	−22 22 31·2	β Corvi, 6 obs.

"The rest of the October observations cannot be reduced until the places of the comparison stars are determined.

Stars of Comparison.

1850.		R.A. 1850·0 h m s	Decl. 1850·0 ° ′ ″	Mag.	
Aug. 29	*a*	3 22 44·34	+58 4 21·3	8·9	Arg. Zone 57, No. 125
30	*b*	34 13·17	58 0 54·5	9·10	
31	*c*	3 46 11·04	58 10 46·4	8·9	Arg. Zone 68
Sept. 2	*d*	4 11 7·70	58 7 55·5	8·9	
3	*e*	4 29 8·53	57 55 30·5	15	
8	*f*	5 47 40·92	54 22 15·2	7·8	Arg. Zone 174
	g	5 47 10·63	54 15 58·1	3	B.A.C. 1885
10	*h*	6 18 42·86	51 52 10·4	8·9	
11	*i*	6 34 40·72	50 31 42·1	7	Arg. Zone 76, No. 119
13	*k*	7 6 26·67	43 25 2·4	8	H. C. 14014
20	*l*	8 30 34·70	28 26 10·4	9	
21	*m*	8 39 22·43	25 24 52·1	9	
Oct. 1	*n*	9 49 43·33	+ 0 36 35·0	8	Weisse, 1076

DURHAM. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1850.	Greenwich M.T. h m s	App. R.A. h m s	s	App. N.P.D. ° ′ ″	″	No. of Comps. in R.A.	N.P.D.	Set.
Sept. 13	13 44 54·9	7 2 18·10	−0·056 *p*	43 6 0·0	−0·543 *p*	9	3	(1)
16	13 45 23·2	7 41 46·73	0·050 *p*	49 58 2·0	0·654 *p*	5	5	(2)
17	15 1 48·9	7 55 38·09	−0·047 *p*	52 40 59·5	−0·576 *p*	12	4	(3)

p = Equat. Hor. parallax in seconds of *arc* in both cases.

Assumed Apparent Places of Stars of Comparison.

Name.	R.A. h m s	N.P.D. ° ′ ″	Set.
Lalande, 14384	7 17 10·06	43 10 58·4	(1)
Anonymous, 7th Magnitude	7 42 16·49	50 8 27·4	(2)
Lalande, 15637	7 53 34·16	52 26 57·4	(3)

"The two stars from Lalande are brought up by precession, without modification, from the *Hist. Cél.*

"The anonymous star depends on a single comparison with 63 *Aurigæ.* It requires re-observation. It is preceded by a star a little north of it by 45ˢ, and followed by another, also north, in 30ˢ: both these comparisons being of 7·8th magnitude.

"The comet was best seen here on September 17. I then thought it a little elongated in the north following direction: no nucleus was shown by this instrument."

PARIS. (M. Mauvais.)

1850.	Paris M.T. h m s	R.A. h m s	Dec. ° ′ ″
Sept. 9	13 27 2	6 1 8·63	+53 28 20

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1850.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	Star of Comp. B.A.C.
Sept. 13	12 43 56·8	7 1 41·85	−8·7518	43 1 2·2	−9·8171	2361
	13 24 14·7	7 2 6·14	−8·7644	43 4 20·6	−9·7647	—

The observations are corrected for refraction.

The following place of the star of comparison for 1850·0, is taken from the Radcliffe Observations.

	Mean R.A. h m s	Mean N.P.D. ° ′ ″
B.A.C. 2361	7 4 41·28	42 29 59·3

I. Approximate elements by Mr. G. P. Bond, from the earliest Cambridge (U.S.) Observations.

Per. Pass. 1850, October 19, 3677 Greenwich M.T.
Node .... 205° 53′
Per 89 22
Incl. 40 17
Per. Dist. ...... 0·5642 Motion direct.

II. By Mr. George Rümker.*

T .... 1850, October 19, 33837, Greenwich M.T.
π .... 89° 13′ 41″
☊ 20 1 31
i 40 3 45
Log q . 9·752555 Motion direct.

III. Elements by Mr. Graham from the Senftenberg observation of the 5th, and Markree places of the 9th and 14th, with the Paris observation of the 9th.

	Greenwich M.T.	R.A. ° ′ ″	Decl. ° ′ ″
Normals. Sept.	5·44407	73 55 26	+57 3 10
	9·55935	90 17 19	53 28 8
	14·45529	108 41 32	+45 1 56

Aberration and parallax allowed for.

Elements.

T .... 1850, October 19, 3178, Greenwich M.T.
π .... 89° 3′ 5″ } App. Eq. Sept. 9.
☊ .... 206 1 47 }
i 39 45 44
Log q . 9·75336 Motion direct.

$$x = [9{\cdot}73554] \sin(173^\circ 35' 55'' + v) : \cos^2 \tfrac{1}{2} v$$
$$y = [9{\cdot}74247] \sin(\ 87\ 24\ \ 7 + v) : \cos^2 \tfrac{1}{2} v$$
$$z = [9{\cdot}30650] \sin(213\ 45\ 40 + v) : \cos^2 \tfrac{1}{2} v$$

The elements differ from the middle observation 3′ in right ascension, agreeing in declination.

* Accompanied by an approximate ephemeris.

PETERSEN'S THIRD COMET.

CAMBRIDGE, U.S. (Professor Bond.)

1850.	Cambridge M.T. h m s	R.A. Mean Eq. 1850·0. h m s	No. of Obs.	Decl. Mean Eq. 1850·0. ° ′ ″	No. of Obs.	Comp. Star.	
May 29	11 30 7	17 46 9·6	1	+74 12 45	1	*a*	
	11 52 52	3·8	2	12 30	1	*b*	
31	9 30 0	17 32 52	1	74 3 0	1	Approximate.	
	9 47 53			3 11	1	*a*	
June 1	9 38 51	17 25 42·8	6	73 56 10	3	*c*	
	9 56 18	35·7	3	56 6	3	*b*	Instr. Comps.
3	10 5 14	17 10 50·4	2	73 36 21	2	*b*	Instr. Comps.
	10 5 14	44·1	2	36 18	2	*d*	
4	11 11 35	17 2 55·1	4	73 22 56	2	*e*	
	11 11 35	54·9	4	22 53	1	*f*	
6	9 40 45	16 48 7·3	4	72 52 5	3	*g*	
13	9 41 26	15 55 41·3	4			*h*	
	9 41 26	42·1	4			*i*	
	10 1 55			69 42 8	2	*h*	
	10 1 55			42 7	2	*i*	
19	9 4 26	15 16 36·2	6			*k*	
	9 8 29			64 58 44	3	*k*	
21	9 13 12	15 5 10·9	4	62 53 46	2	*l*	
26	9 44 18	14 40 9·7	6			*m*	
	10 7 52			56 19 11	2	*m*	
July 4	10 4 2	14 9 50·0	8	41 12 27	4	*n*	
6	10 9 45	14 2 42·4	14	36 33 14	3	*o*	
	11 36 48	31·2	6	24 14	2	*p*	
	11 36 48	31·5	6	24 14	2	*q*	
8	8 58 26	13 58 19·5	3	31 26 12	2	*r*	
	12 35 10	57 54·6	8	2 9	3	*s*	
9	8 53 4	13 55 42·1	8	28 45 39	5	*t*	
10	8 45 18	13 52 50·1	4	26 1 22	1	*u*	
	9 10 0	53 8·6	12	25 58 32	4	*v*	
17	8 48 41	13 38 5·4	12	+ 5 47 0	3	*w*	
22	8 45 29	13 29 26·5	4	− 7 54 57	4	*x*	
23	8 21 9	13 27 53·9	3	10 23 46	1	*y*	
	8 21 9	54·5	3	23 42	1	*z*	
	9 0 32	52·4	9	27 40	3	α	
24	8 39 30	13 26 22·9	4	12 51 44	1	β	
	9 6 23	20·6	8	54 33	2	γ	
25	8 58 5	13 24 54·0	4	−15 14 16	2	δ	
26	8 41 53	*+ 1 21·62	6	*+ 2 4·4	3	ε	
29	8 33 59	*− 2 34·92	4	*− 0 23·9	1	ζ	

Mean Places of the Stars of Comparison.

1850.		R.A. h m s	Decl. ° ′ ″	
May 29	*a*	17 40 7·94	+74 5 21·7	H.C. 32630
	a	6·97	16·1	Arg. Zone, 126
	b	36 50·29	74 19 1·9	B.A.C. 6001
June 1	*c*	26 45·36	73 53 30·9	Determined July 23, from *c′*
	c′	40 38·90	73 54 51·4	Arg. Zone, 126
3	*d*	17 4 29·87	73 31 5·0	Gr. 2420, Radcliffe Obs.
4	*e*	16 59 17·55	73 21 10·2	B.A.C. 5769
4	*f*	17 3 34·24	73 24 12·0	Gr. 2481, Radcliffe Obs.
6	*g*	16 43 12·61	72 57 6·1	Arg. Zone, 126
13	*h*	15 59 32·23	69 38 38·9	Arg. Zone, 114
	i	59 54·48	69 39 18·9	Arg. Zone 114
19	*k*	17 41·44	65 2 38·1	Determined July 24, from *k′*
	k′	12 13·77	65 27 22·3	Arg. Zone 112
21	*l*	17 9·52	63 0 48·3	Gr. 2224, Radcliffe Obs.
26	*m*	14 35 4·76	56 20 57·3	Arg. Zone 5
July 4	*n*	10 21·24	41 5 58·9	B. Z. 472
6	*o*	2 6·12	36 38 11·4	B. Z. 416
	o	6·19	28·1	B. Z. 466
	o	5·97	21·7	Determined July 23, from *p* and *q*
	p	5 31·09	25 30·1	B. Z. 466
	q	14 6 46·41	36 25 29·1	B. Z. 416
	q	46·49	33·6	B. Z. 466
8	*r*	13 59 47·31	31 34 15·9	H. C. 25935
	s	56 10·83	31 3 17·6	H. C. 25828
9	*t*	56 25·73	28 43 39·3	B. Z. 471
10	*u*	54 18·37	26 5 12·8	B. Z. 462
	v	52 50·10	25 58 8·0	Compared with *u*
17	*w*	38 35·33	+ 5 52 17·5	H.C. 25380
	w	35·38	10·1	B. Z. 83
22	*x*	33 44·76	− 7 56 38·2	B.A.C. 4565
23	*y*	17 17·73	10 22 36·6	α Virginis
	z	25 54·85	10 22 59·0	Weisse, H. xiii. 430
	α	24 10·32	10 28 33·6	Weisse, H. xiii. 397
24	*β*	30 28·25	12 47 21·7	H. C. 25179
	β	28·38	24·4	Weisse, H. xiii. 520
	γ	24 49·94	13 1 43·7	Weisse, H. xiii. 412
25	*δ*	13 19 27·71	−15 11 43·0	B.A.C. 4494
26	*ε*	13 22 10	−17 32	Approximate
29	*ζ*	13 22 17	−23 41	———

"This comet has always presented a very decided stellar nucleus, a small star shining through the nebulosity."

London:—Printed by G. Barclay, Castle St. Leicester Sq.

ROYAL ASTRONOMICAL SOCIETY.

Vol. XI. *December* 13, 1850. No. 2.

G. B. Airy, Esq., President, in the Chair.

Thomas Barneby, Esq., Worcester;
Thomas Turner Wilkinson, Esq., Burnley, Lancashire; and
Sir William Keith Murray, Bart., Stonehaven,
were balloted for and duly elected Fellows of the Society.

Signor A. de Gasparis was balloted for and duly elected an Associate of the Society.

We announce with great sorrow that our respected and venerable associate, Professor Schumacher, died at Altona on the 28th of December last. The Council would gratefully receive any particulars of his life and valuable publications for the *Annual Report.*

On a Method of regulating the Clock-work for Equatoreals. By the President.

The President resigned the Chair to the Rev. R. Sheepshanks, and gave orally an account of a communication from himself to the Society, which he had placed in the hands of the Secretary. The subject of this paper is supplementary to that of a paper (presented to the Society several years since and printed in their *Memoirs*), "On the Regulator of the Clock-work for Equatoreals." It was shown in that paper, by mathematical investigation, that when the motion of clock-work is regulated by centrifugal balls, whether those balls be suspended to a vertical axis or to a cross-piece carried by a vertical axis, or whether the axis be or be not loaded with a fly-wheel, the balls may alternately approach to and recede from the vertical position, and the angular motion may therefore be irregular. And it was pointed out as a fact of observation that there is frequently a strong tendency to this irregularity: and this was completely explained by remarking that, if the balls once receive in the slightest degree the elliptic motion which produces these appearances, the friction-resistance by which the clock-work is regulated occurs only when each ball is at the extremity of the major axis of its ellipse, and that the effect of resistance at this place is to diminish, not the major but, the minor axis of the ellipse, and thus to render it more and more strongly elliptical. The

purpose of the present paper was to point out a practical corrective of this inequality of movement: and the following was laid down as a general theorem, of which, in any special case, it is not difficult to give mathematical proof. If a part of the machinery can be selected, so connected with the revolving parts, that when the balls revolve in a circle, that part will be at rest, and when the balls revolve in an ellipse that part will oscillate; and if the movement of that part be subject to friction; then the oscillation and the ellipticity of movement will infallibly be diminished: and if the friction follow such a law that, as the motion diminishes, the friction becomes less than any assignable quantity, then the ellipticity of movement will be diminished without influencing the rate of the clock. The only kind of friction which appears proper for this purpose is the resistance of a perfect fluid to the motion of a plate through it.

Two instances were then pointed out, in which this principle had been successfully applied, though in different ways. The first is in the clock-work of the Liverpool equatoreal; the expansion of the centrifugal balls causes a slider upon the vertical spindle to rise, and elliptic motion of the balls therefore produces oscillation of the slider; the slider is connected by a lever with a plate of metal moving in a vessel of water; and the resistance of this water to the movement of the plate quickly reduces elliptic to circular movement, and produces no effect whatever on the circular movement. The second is in clock-work now in construction for giving uniform movement to a barrel intended to receive the record of transits in the American manner: in this clock-work, which is constructed on principles explained in a former discourse to the Society, a wheel of the clock-train drives the wheel that revolves with the pendulum by the intermediation of a wheel, which is partially free: elliptic motion of the pendulum therefore produces oscillation of the frame carrying the intermediate wheel. This frame is connected with plates moving in vessels of water; and here also the resistance very rapidly reduces the elliptical to circular motion. The President concluded by saying that he considered the practical problem of producing smooth and uniform motion to be now completely solved.

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*Observations of the Planet Saturn, accompanied by his eight Satellites, Nov. 21, 1850, at about 9^m 20^h G.M.T.**

By Mr. Lassell.

"The sky cleared at about 8 P.M., and on going into the observatory at 8½ I found the atmosphere very fine. I scrutinised the planet for some time, with various powers, *e.g.* 219, 567, 614.

* It will be seen that the notices respecting *Saturn*, his rings and satellites, do not admit of classification, without altering the *form* of the communications. The division in the *outer* ring was seen by MM. Lassell and Dawes. Mr. Bond discovered the *inner dusky* ring, which was partially seen by Mr. Lassell just *before he read of Mr. Bond's discovery.*

I several times suspected a second division of the outer ring at both ansæ, but could not *absolutely* verify it. The appearance I saw, or suspected, was a line one-third of the breadth of the outer ring from its outer edge.*

"*Mimas* was first detected with 614, and afterwards seen, even more pleasantly and steadily, with 219, and without any hiding of the planet. Indeed, all the satellites, but *Hyperion*, were exhibited in one view with this power. The sky was very light from the bright moon, and I could not find *Hyperion* with any lower power than 614. I had not calculated its place, nor had I the slightest idea at the moment where it was to be found. When I had detected it, I was astonished by its faintness, and am persuaded that it must vary considerably in brightness, and that when *first* discovered it must have been even at an unusual maximum. I had the greatest difficulty in measuring its position, and was obliged to take its distance from a star in the first instance, and afterwards ascertain the distance of that star from the planet. The dusky south pole and ruddy belt of *Saturn* were very remarkable. The shadow of the ring upon the ball seemed serrated, and the upper edge of the ring crossing the ball seemed a *dark line*, not so broad or strongly marked, however, as the shadow below it.

"The following are measures in position and distance, along and at right angles to a parallel of declination, which may serve, at least, as an approximate epoch of the places of the satellites. The nearest four are estimated: the others are micrometrically measured:—

	″		″		
Mimas	4	South	23	West	Estimated.
Enceladus	6	—	20	East	
Tethys	5	North	28	West	
Dione	10	South	38	West	
Rhea	2	North	80	West	Measured.
Titan	16	South	157	West	
Hyperion	32	North	119·5	East	
Japetus	76	South	201	East	

"A more accurate epoch, however, of the satellites *Titan* and *Rhea*, will be furnished by reference to some observations I made on the 13th Sept., of an inferior conjunction of both of them with the planet.

"1850, Sept. 13,

$11^h\ 55^m\ 23^s$ G.M.T., *Rhea* is optically in conjunction with *Saturn*; a mean of 3 micrometrical measures gave the satellite 18″·0 north of the planet's centre. *Titan* is approaching conjunction, but is evidently a little short.

$11^h\ 59^m\ 38^s$, *Rhea* is not sensibly past conjunction.

* Mr. Lassell sent a sketch showing the position and appearance of this division, which is seen in the woodcut at p. 24.

$12^h\ 3^m\ 40^s$, *Rhea* is now, I think, past conjunction, and *Titan* is very near it.
$12^h\ 15^m$, *Titan* is now fully up to conjunction, and *Rhea* evidently past.
$12^h\ 24^m$, *Titan* is now, I think, *rather* beyond conjunction, but the atmosphere is exceedingly unfavourable.
$12^h\ 27^m$, *Titan* is now apparently past.
A mean of 3 measures gave *Titan* $39''\cdot4$ north of *Saturn's* centre. I estimate the most probable time of conjunction of *Rhea* to be $11^h\ 58^m$, and of *Titan*, $12^h\ 15^m$ G.M.T.

Interior Ring of Saturn.

Great interest has been excited by the discovery at Cambridge, U. S. of an additional *inner* ring to *Saturn*. This was announced in the *Liverpool Albion* by the following paragraph, which was copied into *The Times* of Dec. 3d, 1850:—

"*Discovery of a Third Ring round the Planet Saturn.*—Letters received from Boston by the Africa announce the discovery, on the night of the 15th ult., of a third ring round the planet *Saturn*—a phenomenon which had been for some time suspected. It was announced that this important fact was ascertained by the astronomers at the Observatory at Cambridge. It is interior to the two others, and therefore its distance from the body of *Saturn* must be small. It was well observed through the great equatoreal, with powers varying from 150 to 900; the evening for astronomical observations being remarkably fine, perhaps the finest since the establishment of the Observatory, although, singularly enough, the sky was so hazy, that to the naked eye only the brighter stars were visible. It will be remembered, that the eighth satellite of this planet was also discovered at Cambridge, by Mr. Bond, about two years since."

We believe that no information has been received *directly* from Mr. Bond; but Capt. Smyth has had a letter from the Honourable Edward Everett (dated 26th November last), from which the following extract is taken:—

"Mr. Bond has lately announced the discovery of a third ring of *Saturn*, interior to the other rings. This is not to be confounded with Struve's supposed resolution of the other rings, which Mr. Bond's observations do not confirm. The new ring is believed by Mr. Bond to be thicker than the other rings. Before he had ascertained its existence as a separate body, and while he supposed it to be a part of the inner of the hitherto known rings, he supposed that the thickness of the latter was not uniform, but that it increased towards the planet. This appearance he now refers to the greater thickness of the edge of the newly-discovered ring. He is entirely confident of the reality of the discovery; and such are Mr. B.'s *accuracy and caution,* that I think it may fully be depended upon.

He will before long communicate to the American Academy a full account of it."

The Times containing the news of Mr. Bond's discovery did not reach Mr. Dawes at Wateringbury till December 4,* but on the evening of December 3 an appearance resembling that remarked by Mr. Bond had been noticed by Mr. Lassell, then on a visit to Wateringbury. Mr. Lassell's description, taken from a letter to the Astronomer Royal, is as follows:—

"1850, Dec. 3. Being on a visit of a few days at Wateringbury, the residence of my friend the Rev. W. R. Dawes, the clouds, which had covered the sky uniformly for more than 24 hours, suddenly cleared off about $9^{h}\cdot0$, when we went into the observatory, and turned the telescope, by Merz, of $6\frac{1}{3}$ ins. aperture, and 102·5 ins. focus, on the planet *Saturn*. The eyepiece principally applied was an excellent single lens, magnifying 298 times.

"On putting my eye to the telescope, I was forcibly struck by the beauty of the image, and set myself diligently to observe whatever might present itself. The annexed diagram† is an attempt to represent the planet, with especial reference to an unusual appearance which attracted my eye. After surveying the planet for some time, I was struck with a remarkable phenomenon, which, referring to the diagram, I shall proceed, as well as I can, to describe.

"It appeared as if something like a *crape veil* covered a part of the sky within the inner ring, designated by the letter (*a*). This extended about half way between what I should have formerly considered the inner edge of the inner ring and the limb of the planet, while there was a darker, ill-defined boundary line (*b*) separating this crape-like appearance from the solid body of the inner ring. There was an exceedingly thin line, or shadow, running along the southern edge of the northern portion of the ring where it crossed the planet, and this line seemed somewhat broader at each end, where it touched the limbs of the planet. Mr. Dawes had previously drawn my attention to the appearance of this line before scrutinising the planet."

Extract of a Note from Mr. Hind to the Astronomer Royal.

"Mr. Lassell will probably have written to you relative to a new appearance about *Saturn*, probably the same as that from which Professor Bond has inferred the existence of an interior ring, according to extracts from Boston newspapers, which have been copied into the London daily journals.

* The *independence* of the Wateringbury Observations is of little importance in this case, as Messrs. Dawes and Lassell are too accomplished and experienced observers to see what they wish to see. Their testimony to Mr. Bond's discovery has, however, additional interest and value from this cause.

† This diagram is not given, as it was thought better to make use of a more finished portrait by Mr. Dawes. The letters *a* and *b* refer to the outer and inner edges of Mr. Bond's ring.

"Last evening, about nine o'clock, I had an excellent view of the planet under magnifying powers of 200 and 320, and on careful examination I noticed, chiefly on the side following in right ascension, a faintly illuminated border of light, partly filling up what usually appears to be the black ground of the heavens between the ball and interior edge of inner ring. Its breadth seemed to me about half that of the outer ring, and though I could not discern anything like a division between the faint light and the interior edge of the ring, this might very possibly be owing to want of higher power, which the night did not bear advantageously. The inner edge was *at times* very well defined. The appearance was steadily visible on the side following in right ascension, but I could only perceive it by momentary glimpses on the preceding one. Mr. Lassell's account of his observations upon *Saturn* with Mr. Dawes' refractor, Dec. 3, is perfectly in accordance with the phenomenon I have alluded to above. My observation is therefore merely in consequence of this notification from Mr. Lassell."

A very beautiful drawing of *Saturn*, by Mr. De la Rue, as seen in his 13-inch reflector, will be exhibited at the January meeting. It fully confirms Mr. Bond's discovery, and Mr. Dawes' sketch.

On the Ring of Saturn. By the Rev. W. R. Dawes.

"After the re-establishment of my observatory at my present residence, until the last week in November, the state of the air was very unfavourable for observation. During that week and the first of this month, some good opportunities have occurred; and I beg leave to lay before the Society a few extracts from my observatory journal relating to the telescopic appearances of the ring of *Saturn*, which have been in some respects remarkable.

"1850, Nov. 23. With $8\frac{1}{2}$-foot equatoreal refractor. *Saturn;* power 125. Very brilliant and sometimes sharply defined. Now and then fancied a faint lucid point near the following arm of the ring; but it was not satisfactorily verified with 425. While looking steadily for it (with power 425) some very good views of the planet occurred, and I sometimes suspected that the outer ring had a short and narrow line upon it near its extremity. On scrutinising the preceding arm, I occasionally get the same impression. *Query,* Is the division in the outer ring becoming visible again? *Mem. Ask Lassell to look for it.*"

The following morning I received a letter from Mr. Lassell, dated Nov. 22, in which he says: "Last night, in about a single hour of *fine* sky, I was favoured with a view of *Saturn*, accompanied by his eight satellites; some of them in trying positions." Then follows a diagram of their positions in reference to the planet, at $8^h\ 40^m$ G. M. T.; and also a larger diagram of the planet itself. Mr. Lassell then adds: "I had repeated impressions of a secondary division; and, if it be real, it is one-third of the breadth of the outer ring from its outer edge. The suspicion was the same from both ansæ .... Powers from 219 to 614; full aperture always:" viz. 24 inches.

To proceed with the extracts from my journal.

"Nov. 25. Clear night, and occasionally good telescopic vision. *Saturn*. With 282, I was satisfied that, in finest moments, a very narrow and short line was discernible on the outer ring near its extremities; which was confirmed with power 425, with which the phenomena of the planet were better brought out.

"Nov. 29. Sharp frost; clear sky. *Saturn*, $6^h\ 45^m$ G. M. T. Having applied higher powers, and viewed the planet steadily for a considerable time, I obtained several satisfactory glimpses of a division near the extremity of the outer ring. It was occasionally seen with power 323; but far more certainly with 460. After a few seconds of uncommonly sharp vision, I involuntarily exclaimed, '*Obvious*.' There is a *shading*, like *twilight*, at the inner portions of the inner ring, $7^h\ 30^m$. On looking again at *Saturn*, power 460, I am struck with the beauty of the image, and get frequent glimpses of the division in the outer ring: it is improved by a little illumination of the field, and is usually rather best seen at the *following* extremity.

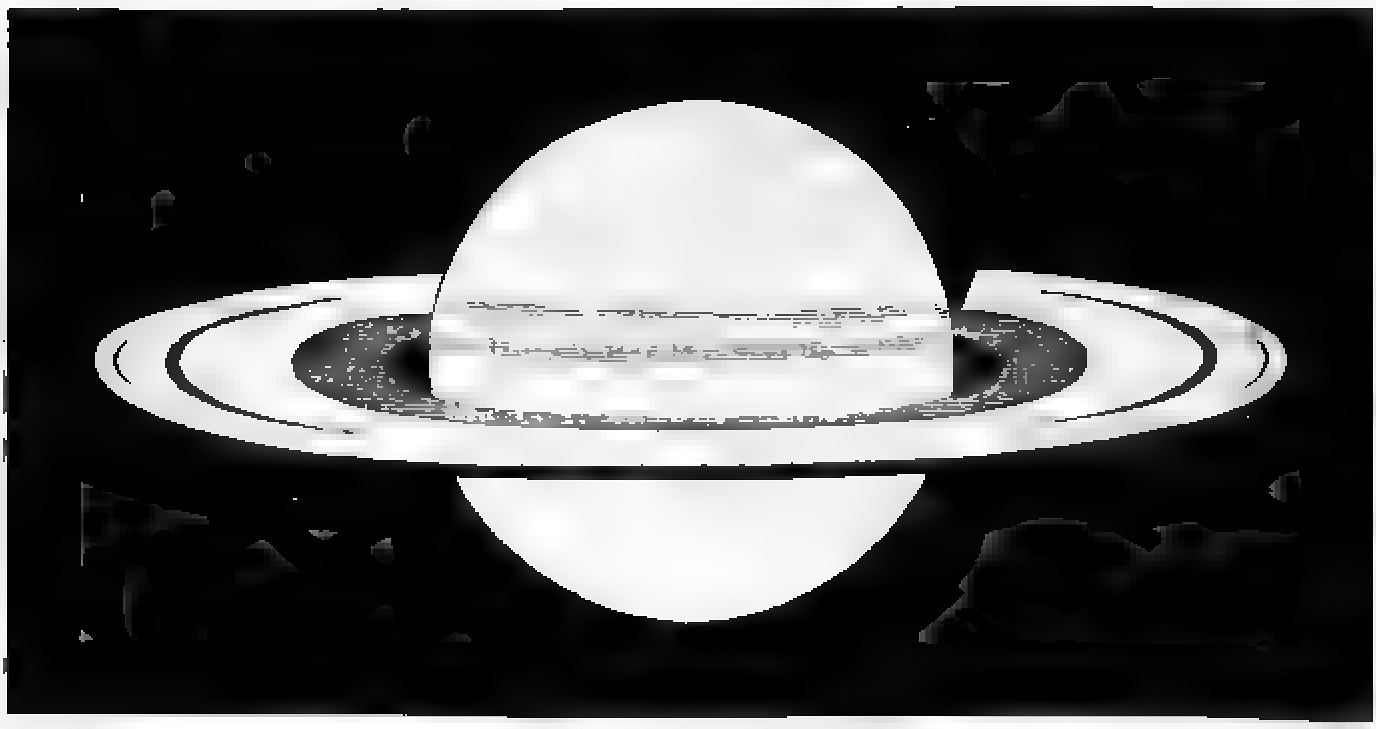
"$8^h\ 40^m$. Examined *Saturn* with the Dollond micrometer and Barlow lens, power 375. Vision is occasionally fine. At times I am pretty sure of the lines on the extremities of the outer ring; but rather most so on the *following* side. The preceding extremity seems rather more dusky than the following one, and scarcely so distinct. There is an exceedingly narrow black line on the ball at the *southern* edge of the ring where it crosses the planet; and it is slightly broader at the east and west edges of the ball than near its middle. It is perhaps one-third the breadth of the shadow of the ring on the ball to the *north* of the ring. What can it be? It looks like a shadow; but how can the shadow of the ring be visible both on the north and south sides of it?

"$8^h\ 55^m$. The interior portion of the inner ring is rather *suddenly* shaded off, and towards the inner *edge* scarcely reflects sufficient light to be always sure of its outline. It has struck me, that the dark line which I see at the southern edge of the ring where it crosses the ball, is nothing else but this shaded, or rather *unreflective*, portion of the ring, which at this part is projected into a very narrow line: but it certainly appears to widen a little towards the edges of the ball. On further consideration, I believe this must be the true explanation of this narrow dark line, which I cannot otherwise account for. The dusky portion of the inner ring, which I have particularly described and recorded to-night, I saw very well, and precisely in the same way, on the 25th; but being then engaged with visitors to the observatory, I did not record the appearance. I then however determined to scrutinise the phenomenon the first favourable opportunity. Its appearance is very much like that of a dull unreflective portion of the moon when the sun is shining upon it very obliquely. I think its breadth is rather less than that of the inner portion of the outer ring."

On Dec. 2d, I was favoured with a visit from Mr. Lassell; and the evening of the 3d proving fine, the telescope was turned upon *Saturn*. A wheel of convex lenses, made by Dollond for Mr. Lassell,

was applied to the telescope; and with these the planet was subjected to a careful scrutiny: immediately after which, Mr. Lassell made the following entry in my observatory journal, accompanied by a sketch of the planet; "1850, Tuesday Dec. 3; 9^h 15^m G. M. T. *Saturn:* 8½-foot achromatic, powers 298 and 363 I find I cannot do justice to the view of the planet; but the phenomenon which struck me as most peculiar was, that the space between the inner diameter of the inner ring and the ball was bisected, or rather half covered, by an appearance as if a crape veil had been thrown over it. There is a dark inner edge to the bright ring, which shades off a little, the dark ring is then of a uniform grey colour: the sky is seen black between Bond's ring and the planet. The belt on the equator of *Saturn* was ruddier than the southern portion, but scarcely more marked;—there being a most striking difference of colour between the whole district south of the northern edge of the belt, and the portion north of that line. I am not certain that I saw any secondary division of the ring. A minute dark line or shadow I also observed running along the southern edge of the ring, where it crossed the front of the ball; and this line was rather broader at its ends, projected on the limbs of *Saturn*, than in the middle." "[This last sentence added on the morning of the 4th, having forgotten to record it at the time.—W. Lassell."]

"Dec. 5, at 7^h G. M. T. Generally star-light, but rather hazy and dull. *Saturn.* The haze is rather too thick for the use of high powers, but during clearer moments, 323 is borne very well; and the definition, though variable, is at times very good. The *obscure ring* is occasionally well seen. I get an impression of a dark shade immediately in contact with the bright ring, but not amounting to black, and certainly not *so* black as the principal division in the ring; yet it is, I think, nearly as broad. Then comes a faintly illuminated ring concentric with the bright one. Its breadth is about equal to the inner portions of the outer ring.



"$7^h\ 30^m$. The planet is a little clearer, and bears 460 very well. With this power, by occasional good views, the phenomena come out more decidedly than with 323 . . . . I cannot distinctly make out any division in the outer ring. On comparing the breadth of the dark shade south of the ring, with the breadth of the obscure portion of the inner ring as seen at the ansæ, it seems to agree in its proportions with the elliptic form of the ring; and I cannot doubt that it is that obscure portion projected on the ball."

A sketch by Mr. Dawes of the appearance of the planet and its rings as subsequently seen by him, is represented in the annexed woodcut. This is only to be considered as an *illustration*, for neither the time nor the material allowed of any very careful rendering. The upper shadings on the body of the planet are incorrect, and may be considered as non-existing.

Remarks on the foregoing extracts.

"1. With reference to the division in the outer ring. It would seem too improbable that the same impression should be received by two observers, in different localities, without previous communication on the subject, and using instruments so different in character as Mr. Lassell's twenty-foot reflector and my refractor, unless there were some real ground for it; and it is therefore very desirable that this point should be carefully examined on every favourable opportunity by those who possess telescopes competent to the work. Very distinct definition with a power of 300 or 400 times is requisite to show it, and the primary division of the ring must appear black and clear. It is worthy of notice too, that on Nov. 23, when I first observed it, I was engaged in looking for a suspected close satellite, and was not examining the ring, or thinking at all about it. The dark line at the extremity of the outer ring obtruded itself several times upon my notice; and after continued scrutiny with power 425, I remained satisfied of its existence. Of course, a very slight disturbance of the image is sufficient to obliterate the appearance, and the impression was obtained from several fine sharp glimpses of only a few seconds in duration,—grievously tantalising indeed, yet quite sufficient to produce conviction. It is true, that this appearance is not always visible, even under favourable atmospheric circumstances; but it is quite possible that this may be a necessary consequence of the condition of the rings themselves.

"2. The appearance of the interior portion of the ring is very different from what I have ever seen before with this or any other telescope. The shading-off of the ring strikes me as far more decided and abrupt, and also as very much darker, than it used to be. Moreover, the interval between the inner edge of the ring and the ball, as I have been accustomed to view it, and as it has been usually depicted, is now encroached upon by what appears like a very faint continuation of the breadth of the inner ring, occupying, perhaps, about four-tenths of the interval between the edge of the ball and the interior boundary of the bright part of the ring. My tele-

scope does not indicate to me that this interior portion is *separated* from the bright ring; for the line of demarcation between them is not so black as the principal division in the ring. It looks rather as though the more diffused shading, or belt, which alone was formerly visible on the interior portion of the bright ring, had contracted into a narrower compass, and become of a far deeper shade.

"It may, perhaps, be worthy of consideration, whether the fact of the total absence of sunshine for fifteen years on the southern side of the ring, from which state it has so recently emerged, may have had any effect in producing the present appearances; and it will be highly interesting to observe whether they become modified as the sun rises higher above the plane of the ring, and as the breadth of the ellipse increases. It must be acknowledged, however, that the circumstances of the planet were in this respect the same in 1791 and the following years, when Sir W. Herschel paid so much attention to its phenomena. In a paper read before the Royal Society, January 23, 1794, he thus sums up the appearances of the double ring:—'The outer ring is less bright than the inner ring. The inner ring is very bright close to the dividing space; and at about half its breadth it begins to change colour, gradually growing fainter; and just upon the inner edge it is almost of the colour of the dark part of the quintuple belt.'

"As Mr. Bond's observations were made with an instrument so superior to mine, and under remarkably favourable circumstances, it is quite possible that they may place the phenomena in a very different light. As however all my observations, with the exception of those on the 5th, were made in total ignorance of any remarkable appearances having been noticed by any other observer, I have thought it desirable to request the Society's acceptance of them.

"That the appearances which have lately forced themselves on my attention when viewed through a telescope of moderate dimensions should not have been noticed by previous observers employing far larger instruments, seems to furnish additional evidence of recent change. Sir W. Herschel diligently observed this planet; yet only on four occasions did he notice anything remarkable in the interior portion of the ring, beyond slight shading off, which is represented in one of his figures of the planet, but is not thought worthy of more particular description than that quoted above. Professor Struve remarks (*Memoirs of the Astronomical Society*, vol. ii. page 517): 'As to a division of the ring into many parts, I have noticed no trace. It is remarkable that the outer ring is much less brilliant than the inner. The inner one, too, towards the planet, seems less distinctly limited, and to grow fainter; so that I am inclined to think that the inner edge is less regular than the others.' At that time the same side of the ring was presented to our view as at present; and the ring was so open that the north pole of the planet was hidden by it. Neither did Sir J. Herschel at the Cape of Good Hope notice anything like the present appearances, though *Saturn was nearly in* the zenith, and the climate so favourable.

"No night has occurred since the 5th of sufficiently fine quality to permit micrometrical measures to be taken of the different portions of the ring; but these I shall endeavour to procure the first opportunity."

VICTORIA.

Some objection has been taken, though, we believe, only by one or two persons in the United States, to the name of *Victoria*, as applied to the new planet discovered by Mr. Hind.* It seems to have been forgotten that her Majesty's name is derived from the goddess, who cannot thereby lose her celestial rights. Victoria was recognised as a deity by those who deified Egeria, &c. "Video Virtutis templum .... Quid Opis, quid Salutis, quid Concordiæ, Libertatis, Victoriæ."—*Cicero de Nat. Deor.* lib. ii. § 23.

The following extract from Mr. Hind to the Astronomer Royal will show that there is no intention of changing the name:—

"Since I received your letter of Oct. 1, I have never entertained the slightest idea that any other name than *Victoria* would be employed in Europe, and consequently have fully intended to adhere to it myself. I am quite sure Mr. Bishop is of the same intention. Professors Schumacher, Gauss, Encke, and Argelander, have adopted this name without hesitation; the only opposition that I am aware of has been offered by a part of the American body of astronomers; and I hope, in course of time, for the sake of uniformity, they will use the European name."

The following note from the Hon. Edward Everett to Captain Smyth relates to the same subject:—

"I perceive that Mr. Hind has received the impression from Mr. Gould (editor of the *Astronomical Journal*), that the American astronomers were not disposed to acquiesce in the name of *Victoria*, proposed by him for the last asteroid. When that name was first proposed, it was considered by some persons to be inconsistent with the principle which had been agreed upon, in reference to the designation of newly-discovered bodies. But as Mr. Hind states that he regards '*Victoria*,' in this connexion, as the name of a mythological personage, I cannot think that its coincidence with that of your sovereign ought to forbid its use. Mr. Bond fully agrees with me in this opinion; and there is no one in this country of higher authority than he on any astronomical question."

* M. Gasparis has a great advantage in having at his choice local deities, Parthenope, Egeria, Ilia, &c., which link the country of the discoverer with his discovery. We ultramontanes have no similar good fortune, unless, as in the present case, the sovereign *should* bear the name of a goddess.

CAMBRIDGE. On the Meridian. (Professor Challis.)

1850.	Green. M.T.	R.A.	N.P.D.	Log $\frac{q}{P}$	Obs.—Calc. R.A.	Obs.—Calc. N.P.D.
	h m s	h m s	° ′ ″		s	″
Sept. 18	11 50 4·7	23 40 36·48	76 38 6·2	−9·7948	−0·26	−2·1
21	35 51·8	38 10·89	77 7 32·4	·7995	−0·13	+0·5
25	17 1·8	35 3·99	77 49 4·0	·8058	+0·34	−0·8
28	11 3 2·6	32 52·13	78 21 28·5	·8106	−0·28	−1·7
Oct. 1	10 49 12·9	30 49·84	78 54 34·1	·8156	−0·25	+0·2
2	44 38·8	30 11·53	79 5 40·6	·8171	−0·21	+1·0
5	31 4·5	28 24·65	79 38 57·8	·8219	−0·29	+0·5
7	22 9·2	27 20·97	80 1 2·4	·8249	−0·17	+1·0
8	17 44·3	26 51·87	11 56·4	·8265	+0·25	−2·1
11	4 37·8	25 32·90	44 20·5	·8310	−0·19	−0·1
12	10 0 19·9	25 10·92	80 54 55·7	·8324	+0·55	−0·1
17	9 39 13·3	23 43·55	81 45 50·6	·8392	−0·26	−0·8
26	9 3 11·3	23 4·58	83 6 24·6	·8496	+0·28	−6·7
29	8 51 42·8	23 23·94	29 35·5	·8525	−0·44	−2·8
Nov. 2	36 51·7	24 16·57	83 57 17·2	·8559	+0·08	−0·6
4	29 36·7	24 53·49	84 9 36·7	·8574	−0·29	−5·1
5	26 1·1	25 13·88	15 27·8	·8581	−0·29	−4·3
8	8 15 26·3	26 26·93	31 32·2	·8600	−0·34	−3·7
14	7 55 0·7	29 37·36	84 57 9·4	·8631	+0·09	−2·3
23	26 0·2		85 19 51·1	−9·8657		−0·2
29	7 7 37·9	23 41 15·13			+0·28	

"The observations generally were uncertain on account of the faintness of the planet. On Nov. 2 it was brighter than usual. The places are compared with M. Yvon Villarceau's Ephemeris, in No. 741 of the *Astronomische Nachrichten.*"

Northumberland Equatoreal.

1850.	Green. M.T.	R.A.	Log $\frac{p}{P}$	N.P.D.	Log $\frac{q}{P}$	No. of Comps.	Stars
	h m s	h m s		° ′ ″			
Sept. 16	14 39 53·9	23 42 8·93	+8·434	76 20 34·1	−9·8154	1	(*a*)
	15 10 52·8	8·58	+8·495	40·8	−9·8244	3	(*b*)
Dec. 19	7 20 42·4	0 3 14·25	+8·092	84 54 2·3	−9·8642	5	(*c*)
20	7 49 22·9	0 4 30·42	+8·245	84 50 41·6	−9·8655	8	(*d*)

Assumed *Apparent* Places of the Stars.

	R.A.	N.P.D.	Authority.
	h m s	° ′ ″	
(*a*)	23 48 27·44	75 59 25·2	B. (Weisse) xxiii. 992
(*b*)	23 37 52·59	76 9 3·1	— — 776
(*c*)	0 5 8·26	84 39 12·4	— O. 83
(*d*)	0 5 41·19	84 40 5·0	— O. 95

"A comparison with M. Villarceau's ephemeris gives the following results :—

	Obs. R.A.	Calc. N.P.D.
	s	″
Sept. 16	−0·04	−3·4
Dec. 19	+0·56	5·7
20	+0·41	−8·3

giving to the sets of Sept. 16, weights proportional to the number of observations."

LIVERPOOL. Equatoreal. (Mr. Harthup.)

1850.	Green. M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	Compd—Obsd R.A. s	Compd—Obsd N.P.D. ″	Star of Comp.
Nov. 14	6 57 29·8	23 29 36·23	84 56 55·2	−0·40	+3·8	B.A.C. 8177
16	7 34 48·5	30 52·88	85 3 38·3	0·41	5·2	— —
27	6 6 9·7	39 23·42	24 2·4	0·41	5·1	— 8233
28	9 55 11·0	40 26·36	24 42·8	0·50	4·2	— —
29	7 27 27·7	41 16·23	25 0·7	0·60	5·7	— —
Dec. 5	6 49 18·1	47 9·91	23 6·7	0·48	6·4	— —
9	5 48 25·5	51 24·62	18 12·2	0·61	6·1	— —
11	9 44 51·6	53 50·04	14 22·7	0·57	4·4	— —
12	6 15 26·6	54 48·62	12 35·5	0·60	7·5	— —
13	9 40 17·6	23 56 7·77	85 10 4·9	0·47	7·9	— 8233
19	6 11 13·2	0 3 10·86	84 54 8·4	0·70	5·4	— 8331
21	8 39 33·5	0 5 48·95	84 47 10·1	−0·62	+7·1	— —

The observed places are corrected for refraction and parallax.

The parallax and computed places were deduced from M. Yvon Villarceau's ephemeris, contained in the *Astronomische Nachrichten*, No. 741.

The following are the assumed *mean* places of the stars of comparison for 1850·0.

	R.A. h m s	N.P.D. ° ′ ″	Authority.
8177 B.A.C.	23 20 21·62	84 26 40·00	Greenwich 12-year Catalogue.
8233* —	23 32 14·15	85 11 10·71	— — —
8331 —	23 51 36·64	83 58 1·79	— — —

The right ascension of 8233 from Greenwich Observations for 1848; the north polar distance from Greenwich Twelve-year Catalogue.

" The following results are derived by comparison of the observations, page 5, with the ephemeris of M. Villarceau, after correcting the places for the erroneous assumed value of B.A.C. 8233.

1850.	Ephem. R.A. s	Obs. N.P.D. ″	1850.	Ephem. R.A. s	Obs. N.P.D. ″
Sept. 17	+0·04	+5·5	Oct. 11	+0·01	−0·9
21	·03	+1·0	21	+0·04	+2·0
26	·06	+0·5	23	−0·11	−0·2
28	·20	−0·3	26	−0·01	−0·3
Oct. 1	·27	+1·3	Nov. 2	−0·23	+2·5
4	·13	+0·3	8	−0·21	+3·2
Oct. 5	+0·09	+1·1	Nov. 12	−0·25	+3·8

* " The assumed mean places of B.A.C. 8233, or *γ Piscium*, at page 5, was deduced from the annual proper motion given in that catalogue. I have now adopted the Greenwich right ascension in 1848 brought up with the annual variation from the same authority. The former mean right ascension for 1850 was assumed = *23ʰ 32ᵐ 14ˢ·40.*"

Hamburg. (M. Rümker.)

1850.	Hamburg M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″	
Nov. 9	8 12 27·7	351 43 34·9	+5 23 49·6	Mer.
12	8 2 12·5	352 6 47·8	10 32·5	Mer.
	8 8 2·7	52·0	30·5	Eq.
13	8 43 16·8	15 28·7	5 6 31·3	—
15	8 54 55·2	33 54·7	4 59 17·0	—
16	9 12 24·7	352 43 39·1	56 18·4	—
28	8 51 24·5	355 5 39·1	35 13·6	—
29	6 21 4·7	18 1·4	34 53·9	—
30	7 5 6·9	355 32 33·2	+4 35 2·2	Mer.

Apparent place of a star of comparison from meridian observation.

1850.		h m s		° ′ ″
Nov. 29	App. R.A. =	23 42 22·63	App. Dec.	+4 34 14·1

Haverhill. (Mr. W. W. Boreham.)

1850.	G.M.T. h m s	R.A. h m s		N.P.D. ° ′ ″		Star of Comp. Weisse.
Oct. 1	11 20 42	23 30 49·17	+0·006 *p*	78 54 50·5	−0·657 *p*	xxiii. 647
2	10 26 53	30 12·56	−0·0004 *p*	79 5 34·2	−0·659 *p*	— 610
5	8 36 57	28 27·02	−0·045 *p*	79 38 3·1	−0·678 *p*	— 570
16	8 39 24	23 58·07	−0·012 *p*	81 35 32·5	−0·694 *p*	— 421
17	7 32 15	23 23 44·92	−0·02 *p*	81 45 5·07	−0·706 *p*	xxiii. 421

Comparison with the Ephemeris of M. Y. Villarceau.

	Observation—Calculation. R.A. s	N.P.D. ″		Observation—Calculation. R.A. s	N.P.D. ″
Oct. 1	−0·40	+ 6·6	Oct. 16	−0·42	+ 5·8
2	+0·01	+ 6·5	17	−0·45	+10·5
5	−1·33	−21·5			

Washington. Equatoreal. (Lieut. Maury.)

1850.	Washington M.T. h m s	Obs.	Star.	R.A. h m s	Dec. ° ′ ″
Oct. 28	10 11 13·7	10	*a*	23 23 18·63	+6 35 47·4
29	8 44 58·6	10	Santini 1636	23 26·60	+6 28 46·4
	9 16 40·4	4	*a*	27·05	41·9
31	7 39 36·4	14	Santini 1636	23 49·19	+6 14 52·1
	10 13 1·8	4	— —	50·61	8·9
Nov. 1	7 33 40·9	14	— —	24 3·52	+6 8 9·3
	8 28 54·9	6	— —	4·00	7 54·3
2	8 15 7·6	5	— —	24 20·08	+6 1 26·8
	9 0 1·5	5	— —	20·45	14·9
4	8 16 7·7	11	*b*	24 57·96	+5 49 9·2
	8 53 47·7	5	—	58·68	48 59·2
5	7 48 52·7	4	B.A.C. 8177	23 25 18·56	+5 43 26·8
	7 52 26·8	6	Weisse, xxiii. 458	18·73	25·9

Adopted Mean Places for 1850·0 of Comparison-Stars.

Star.	Mag.	R.A. h m s	Dec. ° ′ ″	Authority.	No. of Comp.
a	9·10	23 25 0·74	+6 41 13·7	Comp[d]. with Weisse, xxiii. 452.	8
Santini 1636*	7·8	24 35·10	+6 15 31·8	Santini, Mem. R.A. Soc. vol. xii. p. 273.	
b	9·10	25 32·76	+6 1 38·0	Comp[d]. with Santini, 1636.	10
B.A.C. 8177	5	20 21·69	+5 33 21·1	Brit. Ass. Cat.	
Weisse, xxiii. 458	8·9	23 22 44·27	+5 35 58·2	Weisse.	

Ephemeris. By M. Yvon Villarceau.

(Extracted from *Comptes Rendus*, No. 20, Nov. 11, 1850, p. 681.)

For Paris Mean Noon.

1850.	R.A. h m s	Decl. ° ′ ″	Log. Δ
Dec. 1	23 42 51·38	+4 34 43·5	0·21053
2	43 49·76	34 53·3	·21415
3	44 49·23	35 14·8	·21776
4	45 49·76	35 47·8	·22135
5	46 51·34	36 32·0	·22493
6	47 53·93	37 27·5	·22850
7	48 57·53	38 33·9	·23206
8	50 2·10	39 51·1	·23560
9	51 7·61	41 18·8	·23912
10	52 14·06	42 57·0	·24263
11	53 21·42	44 45·3	·24612
12	54 29·65	46 43·7	·24960
13	55 38·76	48 51·9	·25306
14	56 48·72	51 9·7	·25650
15	57 59·50	53 37·0	·25991
16	23 59 11·09	56 13·4	·26332
17	0 0 23·46	+4 58 58·9	·26670
18	1 36·60	+5 1 53·3	·27007
19	2 50·50	4 56·4	·27342
20	4 5·12	8 7·9	·27675
21	5 20·47	11 27·8	·28006
22	6 36·51	14 55·8	·28335
23	7 53·24	18 31·7	·28662
24	9 10·66	22 15·5	·28988
25	10 28·74	26 6·9	·29311
26	0 11 47·47	+5 30 5·8	0·29632

* This star is the same as xxiii. 532 of Weisse's Catalogue, and is from Bessel's Zone 38. There is an error of one minute of time in the right ascension in Weisse; this has been made in the reduction from Bessel. The mean place for 1850·0 is as given above.

1850.	R.A. h m s	Decl. ° ′ ″	Log Δ.
Dec. 27	0 13 6·85	+5 34 12·0	0·29952
28	14 26·86	38 25·4	·30269
29	15 47·49	42 45·8	·30585
30	17 8·72	47 13·2	·30898
31	18 30·54	51 47·3	·31209
32	0 19 52·95	+5 56 28·0	0·31519

EGERIA.

Hamburg. (M. Rümker.)

1850.	Green. M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″	
Nov. 15	7 18 10·7	27 9 38·5	+8 24 1·7	Eq.
	10 10 5·9	7 52·5	21·7	Mer.
16	7 0 29·4	26 56 8·7	26 28·3	Eq.
20	9 24 39·0	26 3 31·6	37 48·4	—
25	9 22 8·2	25 8 2·7	54 11·4	—
26	6 59 15·4	24 59 12·0	57 18·4	—
	9 18 14·2	58 16·9	8 57 48·8	Mer.
28	6 12 22·6	24 40 53·2	9 4 30·4	Eq.
29	8 56 44·0	24 31 12·2	8 49·5	—
30	6 46 4·5	24 23 42·3	+9 12 43·1	—

"*Apparent* places of comparison stars derived from observations with the meridian circle."

1850.	App. R.A. h m s	App. Decl. ° ′ ″
Nov. 16	1 46 57·03	+8 27 23·2
	1 52 52·08	8 29 12·0
26	1 46 31·14	8 47 42·0
	1 46 17·54	8 51 50·5
29	1 42 25·55	+9 4 5·7

Elements. By Mr. George Rümker.

	(1.) From obs., Naples, Nov. 2; Hamburg, 20th; Altona, 13th. ° ′ ″		(2.) Naples, Nov. 2; Hamburg, Nov. 29, Dec. 26. ° ′ ″	
M……	288 37 17·1	Nov. 2·0 …………	298 41 31·87	Jan. 0, 1851
ϖ ……	116 26 49·4	………………………	119 40 8·02	
☊ …	43 35 24·4	………………………	43 20 19·06	
i ……	15 57 59·8	………………………	16 26 49·33	
ϕ ……	5 31 9·4	………………………	5 4 11·00	
e ……	0·0961805	………………………	0·0883679	
μ ……	866″·2216	……………… log μ	2·9350437	
Log a	0·4082517	………………………	0·4099753	

For Greenwich Mean Time and to Mean Equinox, 1851·0.

Nov. 29, Calcul.—Observ. = +0″·10 in Long. +0″·02 in Lat. by 2d Elements.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1850.	Greenwich M.T.	R.A.	$\log \frac{p}{P}$	N.P.D.	$\log \frac{q}{P}$	Star of Comp.
	h m s	h m s	s	° ′ ″	s	
ov. 27	7 57 44.5	1 39 16.35	−8.179	80 58 46.8	−9.8467	B.A.C. 488
	8 17 40.9	15.82	−8.072	44.0	9.8449	— —
	8 37 37.6	15.29	−7.924	40.5	9.8437	— —
28	10 30 43.5	1 38 36.11	+8.084	80 54 38.0	9.8445	— —
	10 50 40.0	35.75	+8.189	35.4	9.8464	— —
	11 10 36.7	35.13	+8.270	32.6	9.8484	— —
29	8 26 35.2	1 38 4.82	−7.941	80 51 5.7	9.8429	— —
	8 46 31.8	4.39	−7.721	2.9	9.8419	— —
ec. 5	8 9 39.5	1 35 15.31	−7.857	80 25 51.6	9.8390	— —
	8 47 3.2	14.64	−6.723	44.1	9.8381	— —
6	7 25 57.9	1 34 53.95	−8.140	80 21 24.4	9.8413	— —
	7 45 54.7	53.62	−8.019	17.2	9.8396	— —
9	6 33 22.0	1 33 59.66	−8.306	80 7 7.9	9.8441	— —
	6 48 19.5	59.52	−8.252	1.7	9.8422	— —
11	10 50 19.2	1 33 29.19	+8.381	79 56 5.0	9.8468	— —
	11 5 16.8	29.27	+8.417	0.7	9.8495	— —
13	11 20 2.6	1 33 9.18	+8.464	79 45 18.4	9.8528	— —
	11 35 0.3	9.08	+8.490	13.6	9.8559	— —
19	7 34 41.2	1 32 52.82	−7.503	79 12 4.5	9.8284	— —
	7 52 38.4	52.79	Mer.	11 57.2	9.8282	— —
21	9 24 37.4	1 33 1.15	+8.234	78 59 27.3	9.8332	— —
	9 39 35.2	1.02	+8.290	23.8	−9.8354	— —

"The observations are corrected for refraction. The corrections to be applied for parallax in time and arc are represented by p and q. P is the equatoreal horizontal parallax."

"The following is the assumed *mean* place of the star of comparison for 1850.0, derived from the Greenwich 12-year catalogue."

	R.A.	N.P.D.
	h m s	° ′ ″
B.A.C. 488	1 29 9.16	78 37 38.80

The errors of Rümker's Ephemeris by the Liverpool observations are as follow.

	Computed—Observed. R.A.	N.P.D.
	s	″
1850. Dec. 19	+11.11	−62.7
21	+12.77	−72.4

CAMBRIDGE. On the Meridian. (Professor Challis.)

1850.	Greenwich M.T.	R.A.	N.P.D.	$\log \frac{q}{P}$
	h m s	h m s	° ′ ″	
Nov. 23	9 31 33.8	1 41 55.35	81 12 33.9	−9.8348
25	22 18.1	40 31.26		
28	8 37.7		80 54 40.7	−9.8324
29	9 4 7.5	38 3.89	80 50 46.7	−9.8319
Dec. 7	8 29 10.9	1 34 34.00		

"*Obtained with difficulty*, the planet being very faint."

Northumberland Equatoreal.

1850.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	No of Comps.	St
Nov. 21	11 57 6·1	1 43 21·00	+8·366	81 18 38·7	−9·8457	10	(
25	10 36 54·1	40 29·11	+8·122	81 5 31·9	−9·8371	4	(
Dec. 5	10 50 34·5	1 35 12·09	+8·358	80 25 9·2	−9·8392	8	(

Assumed *Apparent* Places of the Stars.

	R.A. h m s	N.P.D. ° ′ ″	Authority.
(*a*)	1 41 19·77	81 28 9·6	B. (Weisse) i. 743
(*b*)	41 23·09	81 3 32·1	Cambridge Observation.
(*c*)	1 34 43·38	80 30 28·0	— —

"The star (*c*) is Bessel i. 633. The assumed place of each of the stars (*b*) and (*c*) depends on one transit and one circle observation."

Ephemeris. By M. G. Rümker.

For Greenwich Mean Noon.

1850.	App. R.A. h m s	App. Decl. ° ′ ″	Log. Dist. from Earth.
Dec. 8	1 34 25·15	+9 47 11·9	0·23615
9	34 8·45	9 52 7·5	
10	33 53·63	10 57 9·6	
11	33 40·68	2 18·3	
12	33 29·59	7 33·2	0·24578
13	33 20·34	12 54·6	
14	33 12·93	18 22·3	
15	33 7·35	23 56·2	
16	33 3·59	29 36·2	0·25570
17	33 1·62	35 22·3	
18	33 1·45	41 14·3	
19	33 3·05	47 12·2	
20	33 6·41	53 16·0	0·26584
21	33 11·51	10 59 25·6	
22	33 18·34	11 5 40·9	
23	33 26·89	12 1·8	
24	33 37·14	18 28·3	0·27612
25	33 49·09	25 0·3	
26	34 2·72	31 37·6	
27	34 18·02	38 20·3	
28	34 34·97	45 8·4	0·28646
29	34 53·55	52 1·7	
30	35 13·75	11 59 0·1	
31	35 35·55	12 6 3·6	
1851. Jan. 1	35 58·93	13 12·1	0·29681
2	36 23·88	20 25·6	
3	36 50·38	27 43·9	

1851.	App. R.A. h m s	App. Decl. ° ′ ″	Log Dist. from Earth.
Jan. 4	1 37 18·42	+12 35 6·9	
5	37 47·98	42 34·6	0·30711
6	38 19·04	50 6·9	
7	38 51·58	12 57 43·8	
8	39 25·57	13 5 25·0	
9	40 1·00	13 10·5	0·31730
10	40 37·84	21 0·2	
11	41 16·08	28 54·0	
12	41 55·70	36 51·8	
13	42 36·68	44 53·5	0·32734
14	43 18·98	13 52 58·9	
15	44 2·59	14 1 7·9	
16	44 47·49	9 20·4	
17	1 45 33·65	+14 17 36·4	0·33720

For comparing with observation, the time due to aberration must be applied to Greenwich Mean Noon.

An ephemeris by M. Vogel of Berlin, on the *same elements* was very kindly communicated by Dr. Petersen. We give the latter portion of it as a finding ephemeris :—

For 8 p.m. Berlin Mean Time.

1851	R.A. h m s	Decl. ° ′	1851.	R.A. h m s	Decl. ° ′
Jan. 17	1 45 48	+14 20·1	Feb. 4	2 3 6	+16 57·2
18	46 35	28·5	5	4 14	+17 6·3
19	47 24	36·9	6	5 22	15·5
20	48 14	45·3	7	6 32	24·7
21	49 6	+14 53·8	8	7 43	33·9
22	49 59	+15 2·3	9	8 55	43·1
23	50 53	10·0	10	10 8	+17 52·3
24	51 48	19·5	11	11 23	+18 1·5
25	52 44	28·2	12	12 38	10·8
26	53 41	36·9	13	14 53	20·1
27	54 39	45·7	14	15 8	29·4
28	55 38	+15 54·5	15	16 25	38·7
29	56 39	+16 3·4	16	17 43	48·0
30	57 41	12·3	17	19 2	+18 57·3
31	58 44	21·2	18	20 22	+19 6·6
Feb. 1	1 59 48	30·1	19	21 42	15·9
2	2 0 53	39·1	20	23 4	25·2
3	2 1 59	+16 48·1	21	2 24 26	+19 34·5

Log Δ.

Jan. 15	0·3330	Jan. 31	0·3706	Feb. 12	0·3961
19	0·3427	Feb. 4	0·3794	16	0·4040
23	0·3523	8	0·3879	20	0·4116
27	*0·3616*				

METIS.

Extract of a Letter from Mr. Graham, 16 October, 1850.

"A meridian observation of *Metis*, obtained here on the 11th, has fully confirmed what I had previously good reason to suppose, that my last published elements of the planet are much wider from the truth than the previous ones.

"The observation gives,—

1850.	G.M.T. h m s	R.A. h m s	Decl. ° ′ ″
Dec. 11	17 9 59·8	9 58 22·72	+18 55 15·0

Corrected for Parallax, not for Aberration.

"This differs nearly 7^s in right ascension, and $23''$ in declination from the place deduced from the elements.

"As the observation was satisfactory, I set to work without delay, and have obtained the following set of elements,—

To Mean Equinox of Epoch 1848, May 0·0,

		° ′ ″
M	....	144 19 41·25
$\varpi - \Omega$	....	2 33 24·33
Ω	....	68 27 46·76
i	....	5 35 48·03
ϕ	....	7 3 27·32
μ'	....	962″.6884

"These are for the instantaneous ellipse at epoch.

"The places from which these are deduced are the two of 1848, May 15·0, and 1849, Aug. 31·5, previously made use of, and the meridian observation given above, viz.,—

Greenwich M.T.	Long. ° ′ ″	Lat. ° ′ ″
1848, May 15·0	220 37 11·17	+3 26 7·805
1849, Aug. 31·5	327 9 39·75	−9 29 37·54
1850, Dec. 11·70619	145 8 43·65	+6 8 9·11

Corrected for Aberration, and referred to the Mean Equinox of the respective dates.

"Taking into account the perturbations as usual, the residual differences are,—

Observed—Calculated

In Longitude. ″	In Latitude. ″
−0·29	+0·03
−0·10	+0·04
−0·39	0·00

"The place calculated from these elements differs from the observation of Oct. 21, 1850, by,—

In Longitude. ″	In Latitude. ″
+17·76	−2·24

"I had not much faith in this observation, though taken with all the care I could command; but in default of a better I made the

most of it, and as it turns out made too much of it. The extraordinary circumstance is, that an error so comparatively trifling should have such an enormous effect on the results; for, so far I can see, those results agree with the places of 1848, May 15; 1849, Aug. 31·5; and 1850, Oct. 21; as closely as 7-figure logarithms would admit of. It may be worth while to examine this subject more narrowly, but I have not leisure at present. It is certainly the most remarkable circumstance that has occurred in the course of my calculations.

"I subjoin the effect of perturbation by the *Earth*, *Mars*, *Jupiter*, and *Saturn*, from 1848, May 0·0, to,—

	δL	$\delta \pi$	$\delta \Omega$	δi	$\delta \varphi$	$\delta \mu$
1850.	″	″	″	″	″	″
Dec. 16	−211·07	+145·40	−41·57	−1·984	−120·45	−0·0607
1851.						
Jan. 5	191·39	170·30	42·09	2·017	120·38	0·0773
— 25	165·86	200·26	42·90	2·057	120·16	0·0996
Feb. 14	134·03	235·74	44·06	2·099	119·78	0·1279
Mar. 6	95·69	277·04	45·60	2·139	119·25	0·1625
— 26	50·99	324·24	47·58	2·169	118·57	0·2032
Apr. 15	− 0·20	377·43	50·07	2·183	117·78	0·2499
May 5	+ 56·37	+436·73	−53·12	−2·171	−116·93	−0·3021

CAMBRIDGE. Northumberland Equatoreal. (Prof. Challis.)

	Greenwich M.T.	R.A.	Log. $\frac{p}{P}$	N.P.D.	Log. $\frac{q}{P}$	No. of Comps.	Star.
1850.	h m s	h m s		° ′ ″			
Oct. 21	12 32 5·6	8 58 42·09	−8·638	69 25 30·0	−9·8813	8	(a)
29	12 28 28·0	9 11 18·90	−8·633	69 56 12·9	−9·8742	1	(b)
Dec. 5	11 51 56·4	9 54 20·27	−8·623	71 9 53·6	−9·8433	7	(c)

Assumed *Apparent* Places of the Stars.

	R.A.	N.P.D.	Authority.
	h m s	° ′ ″	
(a)	8 55 11·44	69 20 51·8	H.C. {17857, 17861}
(b)	9 16 19·83	69 34 21·1	B.A.C. 3206
(c)	9 55 32·46	71 3 22·8	H.C. {19628, 19629}

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

	Greenwich M.T.	R.A.	N.P.D.	Star of Comp.
1850.	h m s	h m s	° ′ ″	
Dec. 5	12 20 59·4	9 54 20·86	71 10 7·6	B.A.C. 3453
	12 50 56·2	21·94	8·5	— —
11	12 34 44·0	58 16·19	4 58·3	— 3506
	12 54 41·8	16·72	56·0	— —
13	12 25 56·8	9 59 20·02	71 1 53·1	— —

The observations are corrected for refraction and parallax: log. Δ for parallax has been taken from Mr. Graham's ephemeris.

The following are the Assumed *Mean* Places of the Stars of Comparison for 1850·0 :—

	R.A. h m s	N.P.D. ° ′ ″	Authority.
B.A.C. 3453	9 59 8·85	72 30 29·50	Green. 12-year Catalogue.
— 3506	10 8 5·40	71 30 54·24	Edinburgh Observations.

Ephemeris. By Mr. Graham.*

G.M.T.	*True* R.A. h m s	*True* Decl. ° ′ ″	Log. Δ.
Dec. 2·0	9 51 30·63	+18 49 56·5	0·2245
7·0	55 19·27	50 55·6	·2109
12·0	9 58 25·71	18 56 3·6	·1974
17·0	10 0 47·39	19 5 53·2	·1840
22·0	2 21·72	19 33·1	·1709
27·0	3 6·12	19 38 6·2	·1583
32·0	10 2 58·44	+20 1 6·1	0·1463

FAYE'S COMET.

CAMBRIDGE. Northumberland Equatoreal. (Professor Challis.)

1850.	Greenwich M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	No. of Comps.	Star.
Nov. 28	8 40 30·1	21 29 20·38	+8·530	97 11 40·1	−9·9161	5	(*a*)
29	7 46 55·4	30 53·72	8·430	97 9 46·7	·9228	8	(*a*)
Dec. 6	6 22 32·7	42 30·93	8·243	96 51 46·6	·9281	4	(*b*)
7	8 0 46·8	21 44 22·33	+8·502	96 48 14·7	−9·9177	3	(*c*)

Assumed Apparent Places of the Stars.

	R.A. h m s	N.P.D. ° ′ ″	
(*a*)	21 32 31·80	97 38 54·8	B. (Weisse) xxi. 781
(*b*)	39 45·89	96 36 17·9	— — 937
(*c*)	21 48 15·31	96 32 0·6	H. C. 42725

The R.A. of the star (*b*) in Weisse's catalogue is 1^m in defect.

"The observations of the comet were obtained by my assistant Mr. James Breen, by means of the ephemeris published by Lieut. Stratford. On Nov. 28 and 29, the comet was excessively faint, although the sky was perfectly clear. On Dec. 6 and 7, it was seen with difficulty through a slight degree of mist. The mean value of the factor μ in the ephemeris is $+0·272$, as given by the observations of R.A., and $+0·288$, as given by the observations of N.P.D."

By a more careful comparison, M. Le Verrier finds $\mu = 0·2903$, (see *Comptes Rendus*, Dec. 9, 1850, p. 792), and has furnished the following corrected ephemeris :—

* Lieutenant Stratford has printed and distributed a more detailed and convenient ephemeris of *Metis*.

Ephemeris of Faye's Comet, corrected by M. Le Verrier, from Prof. Challis's Observations, 1850. Communicated in a Letter to Mr. Hind.

0^h Mean Time at Paris.

1851.	R.A. h m s	Decl. ° ′ ″	1851.	R.A. h m s	Decl. ° ′ ″
Jan. 3	22 36 4	−4 25 58	Jan. 27	23 29 33	−0 57 36
7	44 34	3 55 57	31	39 0	−0 17 7
11	22 53 16	3 23 52	Feb. 4	48 34	+0 24 40
15	23 2 7	2 49 54	8	23 58 16	+1 7 35
19	11 7	2 14 7	12	0 8 9	+1 51 28
23	23 20 16	−1 36 40	16	0 18 2	+2 36 10

Lieut. Stratford has issued *two* ephemerides of Faye's comet, one a sweeping ephemeris, by which Professor Challis detected the comet; and a second, for every day and for Greenwich mean midnight, with the corrected value of μ.

MICROMETRICAL MEASURES OF DOUBLE STARS.

Cape of Good Hope. Equatoreal. (Mr. Maclear.)

Date.	Name.	R.A. h m	N.P.D. ° ′	Angle of Position. ° ′	No. of Measures.	Distance. ″	No. of Measures.	
1849·939	α Centauri	14 29	150 12	245 14	10	6·99	20	Satisfact^y.
·939	...	...	...	245 16	10	6·94	20	Ditto.
1850·038	...	...	...	245 56	10	7·20	20	Middling.
·038	...	...	...	245 33	10	7·04	20	Good.
1850·104	...	...	...	246 38	10	7·01	10	Wings.
1849·928	*h* 3823	5 55	121 3	131 38	10	3·94	20	Difficult.
1850·016	Δ 70	8 24	134 14	349 18	10	4·65	10	Excellent.
1850·016	*h* 4128	8 37	149 47	218 23	10	2·13	20	Fair.
1850·030	*h* 4130	8 37	147 0	223 31	10	4·07	10	Faint.
1850·041	R 9	8 41	148 6	111 15	10	4·48	20	Working.
1850·096	*h* 4249	9 42	124 20	127 23	10	3·94	4	Indiff.
1850·096	ν Argûs	9 43	154 23	124 53	10	5·58	10	Indiff.
1850·104	ι Can. Maj.	6 53	118 46	161 12	10	7·48	10	Steady.
1850·107	...	...	...	159 58	10			The same.
1850·131	α Crucis	12 18	152 16	118 48	10	5·57	20	Good.

"The above, excepting ι *Canis Majoris*, are from Sir John Herschel's specific list recommended to be watched.

"The companion to ι *Canis Majoris* is a sharp point, the stars are related in magnitude, as Rigel and his companion. The measurement is very difficult.

"All the measures for distance were by repetition."

Mr. Maclear has also made numerous observations of the following stars for *ascertaining their parallax,* during the years 1842–1849:—

	Double Obs.	Single Obs.		Double Obs.	Single Obs.
β Hydri	3	56	β Crucis	130	31
α Phœn.		4	ι Centaur.	87	28
Achernar	71	5	β —	177	30
Canopus	97	5	β Trianguli	15	93
η Argûs	163	29	α —	8	144
δ Crucis	9	50	α Pavonis	7	4
α —	8	144	α Gruis	21	12
γ —		103			

Second list of Stars in the British Association Catalogue already observed, in which the Right Ascension differs by more than One Second in Time from that Catalogue. By Lord Wrottesley.

B. A. C.	Excess of Observed Mean Place above B. A. C.	No. of Obs.	B. A. C.	Excess of Observed Mean Place above B. A. C.	No. of Obs.
	s			s	
547	−10·84	5	6447	− 2·63	5
5312	− 1·23	2	6505	− 1·24	2
5673	− 6·75	2	6565	− 1·39	5
6059	− 1·15	2	6578	− 2·05	5
6108	− 2·40	3	6613	+ 1·48	2
6132	− 1·68	3	6982	− 1·38	2
6199	− 1·08	5	7006	+ 1·62	5
6213	+ 1·32	6	7063	− 2·31	5
6245	+ 1·32	5	7128	+ 3·96	5
6280	− 4·36	2	7133	+ 1·07	5
6338	− 2·78	3	7150	− 1·38	3
6374	+ 2·00	5	7310	−39·90	5
6396	− 1·29	2	7327	+ 2·20	2
6400	− 2·25	3	7347	−10·34	5
6408	− 2·98	4			

Note on 70 Ophiuchi. By Mr. J. Fletcher.

Recent measures of this star stand thus:—

Observer.	Position.	Distance.	Epoch.	Angr. Velocity.
	° ′	″		° ′
Smyth	126 30	6·25	1838·51	−1 15
—	122 24	6·64	1842·55	−1 1
Jacob	120 12	6·83	1846·25	−0 35
Fletcher	116 59	6·46	1850·65	−0 43

"It would seem that the companion of this highly interesting star has now passed its periastre, and is returning rapidly towards its primary.

"I believe the period will turn out very nearly 90 years."

Extract of an earlier letter from Mr. Maclear.

After mentioning his present course of observation, Mr. Maclear says,—

"Computers and copiers perform the drag-work at comparatively little expense. My experience in this climate shows, that one observer can furnish plenty of common arithmetic for two active computers. There is much of somewhat extraneous work, too, falls in my way—in person—exclusive of the functions officially known at home.

"I am well supported by Mr. Mann: his clear, methodical head has waded through eight years of tide-gauge diagrams. He is now taking a leading share in putting to rights the positions of the smaller objects of the British Association Catalogue. An account of about forty was sent to you, and about an equal number are nearly ready to follow. I cannot exactly say what the probable number of corrections will amount to, but I should think not less than 150. For my absolute right ascension of these, I cannot spare more than two or three observations with the 10-feet transit; because all stars entered in the catalogue as having 'proper motion' worth consideration, must pass that instrument. It is an invidious piece of work, but it is a matter of duty. Sir Thomas Brisbane, I am sure, will feel glad for this scrutiny of the work performed by him and at his cost; and Mr. Rümker will doubtless view the subject in the same light. Lacaille's errors are traceable mostly to *errors of entry:* for by transposing ingress for egress in the *Cœlum Australe*, and bringing up, a star is found which he is supposed to have overlooked. Such errors would happen to any observer, where several objects were in the field. His estimate of the magnitudes of the smaller stars is very rough."

Notice of Communications received lately from Mr. Maclear.

Several memoirs from Mr. Maclear have been received by the Admiralty and forwarded to the Society. As these will probably be printed in full elsewhere, it will be sufficient here to describe the contents very briefly.

The most important is "A Report from the Cape of Good Hope Observatory," giving a full explanatory account of Mr. Maclear's scientific labours up to July 1850. It is arranged under the following heads:

1. Personal establishment.
2. Instruments.
3. Astronomical work performed.
4. Measure of the arc of meridian.
5. Reductions and printing,—some general remarks follow under a sixth head.

A second memoir contains "Particulars relating to the mounting of the equatoreal *Instruments* at the Cape, one in 1847 and another

in 1849." The telescope of the first, 45 inches focus, was mounted on a portable equatoreal stand, and originally belonged to the Cape Observatory. The Astronomer Royal supplied Mr. Maclear with an old polar axis (we believe by Sisson) which was not wanted at Greenwich, and this was prepared for the 45-inch telescope by Mr. Simms. Mr. Maclear received this polar axis in 1846, and, on his return from the survey in the autumn of 1847, mounted it in a suitable building. Up to this time the observatory had no equatoreal except this 45-inch telescope and stand.

In 1849 Mr. Maclear received another equatoreal more worthy of his observatory and its director. This beautiful instrument resembles very nearly that of Mr. Dawes, and indeed most of those which have proceeded from the same artist, Merz of Munich. The object-glass is 6·9 inches aperture, and 8½-feet focal length, and supports the reputation of the school of Fraunhofer.

"A new and more accurate Reduction of the Observation of the Comet of 1843" follows. A former reduction had proved faulty from the inaccurate identification of some of the stars of comparison, *when there was no equatoreal.*

"The Opposition of *Mars* in 1849-50," for the purpose of determining the parallax of the planet and of the sun, forms the fourth memoir. These have been very partially printed in the *Monthly Notices*, vol. x. p. 156, *i. e.* so far as for determining the places of *Mars*, his parallax being *assumed* to be known.

Lastly, we have two portions of a series of "Comparisons with the Heavens of the Southern Stars in the British Association Catalogue." This work was first attempted with *both* instruments, but for reasons which are obvious, Mr. Maclear has now resolved to confine himself to the mural circle alone. The transits by this instrument are *nearly* good enough for the purpose, and can always be made so by a few independent right ascensions of well-selected stars determined subsequently by the transit.

Extract of a Letter from Lieut. Gilliss, U.S.N., to Capt. Smyth, Santiago de Chile, July 28, 1850.

"Can you send me the numbers of the *Monthly Notices* through Mr. Abbot Lawrence, who I am sure will cheerfully forward them through the U. S. State department?

"Our catalogue of southern stars was not commenced until February last, between which time and the 1st of May the observations were almost uninterrupted by cloudy nights. May, June, and July, have afforded me only thirty working nights; an amount of obscure weather heretofore unknown at Santiago during the same periods: but as the winter is regarded as over, it may reasonably be expected we shall not have more than twenty unfavourable nights in the ensuing eight months.

"The field embraced by the five horizontal wires of the circle is 17′, and as they are moveable by a micrometer screw, the belt

or zone swept each night is 24′ wide by 4^h long; more than an hour before and after each zone being given to examination of *all* the instrumental adjustments, necessary in a land where we have sometimes (as this present) monthly no less than five earthquakes; moreover, such course makes each zone independent.

"So far, we have been most struck by the discordancies between our estimated magnitudes and those of Lacaille; discordancies reconcilable only on the supposition of a multitude of variable stars altogether disproportioned to the known number of those in the northern hemisphere of the heavens. Were these differences between us uniform, it would not surprise me, but there are stars in the *same* belt varying much from the brightness he assigned them; others, *not* observed by him, larger than many in the zone that he did; and others, again, which, if existing, are certainly not so large as the 12th magnitude. Below you have a list of corrections necessary to these catalogues of the British Association and Lacaille.

B.A.C. No. 2738 is	No. 3200 Lacaille.
— — 3342.	Unsuccessfully sought three times. Cannot be 12th mag.
— — 3482.	Unsuccessfully sought four times. Cannot be 12th mag. *Observed by two others!*
— — 3586.	Does not exist. Is probably 3599 which we find.
— — 4058.	Lacaille's declination *correct*.
— — 4661.	Unsuccessfully sought twice.
— — 4871.	Does not exist, if so bright as 12th mag.
Lacaille No. 3489.	Brisbane's declin. right. Lacaille in error −7′.
— — 3682.	Declination in error + 5′.
— — 4811.	Declination wrong. Brisbane right.
— — 5105.	Does not exist, if of 9th mag.
— — 5473. } — — 5477. }	One of these does not exist. I cannot tell which, without knowing whether the reduction is correct.
— — 6019.	Does not exist, unless its R.A. is here 7^m too great.
— — 6028.	The computer was *wrong* in subtracting 10^m from the R.A.

"We have reason to think that the companion to *α Scorpii*, which our circle telescope shows very well under ordinary illumination, is also variable, as well as many of the minute stars about *η Argûs;* else I can scarcely conceive that our 52 lines' object-glass would so readily show the two *very minute* ones spoken of by Sir John Herschel in § (81), page 37, of his observations at the Cape, when his 20-feet failed to rescue them from obliteration in the light of the large star. *η Argûs* was undoubtedly brighter than the two stars of *α Centauri* at the date of our measures in March, but is on the wane, and is now very little superior to them. There has evidently been a rapid change in the position of α^1 and α^2 *Centauri*, if the places given in the British Association Catalogue are nearly correct. We have 18 (116 wires) differences of right ascension, and 15 differences of declination measured with the micrometer screw at transit over the meridian; from which it results, that α^1 precedes α^2 by $0^s{\cdot}922$, and is south of it $3''{\cdot}66$. The mean epoch is June 1. An entire revolution of the micrometer-head, *which is above an inch in diameter*, is $27''{\cdot}9$, and the power

under which the measures have been made is 98, which is used for all observations.

"The latitude of Santiago will not vary greatly from 33° 26′ 22″ S., nor its longitude from $4^h\ 44^m\ 19^s$ W.; very different, you will perceive, from the geographical position heretofore assigned. The longitude is the result from three occultations and five culminations of the moon, on the assumption that the tabulated places of the moon and stars are correct."

Note from Mr. Warren De la Rue.

"I have been in the habit, for some time past, of making drawings of the double stars on small black discs, which are cut out from paper which has been previously gummed at the back, and found them so convenient that I sent several to my friends Mr. Lassell and Mr. James Nasmyth. Those gentlemen were pleased with them; and the latter begged me to bring them before the notice of your Society, thinking that observers would be glad of the suggestion. In illustration of their use, I have sent my copy of Smyth's 'Bedford Catalogue,' which contains drawings of several double and multiple stars, as seen with my 13-inch equatoreal reflector of 10-feet focal length."*

On the Longitude of the Observatory of Stonyhurst College. By the Rev. A. Weld.

In determining the difference of longitude between the observatories of Liverpool and Stonyhurst, Mr. Weld received, as might be expected, every assistance from Mr. Hartnup.

The chronometers employed were Nos. 222, 258, and 263, all made by Mr. Shepherd, of Liverpool, with the balance invented by Mr. Hartnup.

They were rated by the Liverpool transit clock (using coincident beats for the comparison) on Oct. 23, 24, and 25. On the 25th, Mr. Weld transported them to Stonyhurst, where they were compared with the sidereal clock at 9 P.M.; and at midnight, several transits being observed in the interval.

On the morning of the 26th, Mr. Weld again compared the chronometers with the Stonyhurst transit clock; set off for Liverpool at $7^h\ 40^m$ A.M.; compared with the Liverpool clock on his arrival, at $10^h\ 30^m$; observed several transits, compared a second time; then started at $4^h\ 30^m$ P.M. for Stonyhurst, where the chronometers were compared with the transit clock on the same evening, and some transits observed.

* The stars and nebulæ are very neatly represented by white on the black ground, and the illustrations, when finished, are readily appended to the text, *in print or manuscript.*

The next day was Sunday. On Monday morning, some stars were observed; the chronometers were then compared with the Stonyhurst transit clock. Mr. Weld started for Liverpool, where, on his arrival, the chronometers were compared with the transit clock.

Mr. Weld considers these observations to form two complete trips from Liverpool to Stonyhurst and back. In the first trip the travelling and stationary rates were considered to be identical; in reducing the second trip the travelling rate was adopted, on Mr. Hartnup's suggestion.

The results are as follows:—

Stonyhurst, East of Liverpool.

	First Trip. m s	Second Trip. m s	Mean. m s
Chronometer 222	2 7·27	2 7·45	2 7·36
— 258	2 7·28	2 7·46	2 7·37
— 263	2 7·40	2 7·34	2 7·37

	m s	
And as Liverpool is	12 0·05	West of Greenwich,
And Stonyhurst	2 7·37	East of Liverpool.
Stonyhurst is	9 52·68	West of Greenwich.

All the observations, comparisons, and computations, are detailed.

On the Nomenclature applied, in some instances, to Stars in the British Association Catalogue. By Mr. Woolgar.

"By the published list of Lunar Occultations for 1851, it appeared that there will be three visible occultations of a star of the 4th magnitude, designated as B.A.C. 845. The first impression is that of surprise that so large a star should not have found a place in the other catalogues: in truth, it is a star familiar to astronomers as *μ Ceti*, Fl. 87. To those only in possession of the Association Catalogue, comprising probably not one-third of the persons who take an interest in such phenomena, will the cause of the expression be intelligible.

"I hope I shall not be accused of depreciating the labours of the late Mr. Baily, when I state that the exclusion from the catalogue of so familiar a designation as that of 87 *μ Ceti* is the consequence of a rule adopted *only just before the catalogue in question was sent to the press:* it is, that in the case of stars common to Ptolemy and Bayer the allotment of constellation is to be conformable to the former, where they disagree.*

"Considering what a firm hold the letters of Bayer have obtained, and that Mr. Baily himself deemed it most advisable to

* See Introduction to the B.A.C. pp. 59, 60.

recur strictly to those letters in the instances where they had been deviated from by Flamsteed or others, it is to be regretted that an exception should have been introduced in the case of this star and of Fl. 85.

"Our respected President, in his 12-year catalogue, has retained the old and familiar appellation, inclosing it, however, between brackets.

"An inspection of the map shows that the star can most easily be included within the contour of *Cetus*."

**On a new Variable Star.* By Mr. Hind.

On the 4th of November a fiery-looking star, of the seventh magnitude, was discovered by Mr. Hind at Mr. Bishop's observatory, Regent's Park, in a position where there is no record of one having been observed previously. It is situate near the star numbered 400 in Hora I. of Weisse's Catalogue, and called a ninth magnitude by Bessel, and is preceded by another, also of the ninth magnitude, at an interval of $9^{s}\cdot1$ and $5' 21''$ further north. The mean place of this variable star for the commencement of 1850 is,

$$\text{R.A. } 1^{h}\,22^{m}\,54^{s}\cdot48 \qquad \text{N.P.D. } 87^{\circ}\,53'\,39''\cdot5.$$

This star is not noticed by Lalande or Bessel, and does not occur on the excellent map recently published by the Berlin Academy, which was formed by Professor Olüfsen, of Copenhagen. There appears no doubt of its proving an interesting variable star. It is worthy of remark that the ruby or fiery colour is precisely similar to that which characterises several other stars, known to be of changeable brilliancy, which have been detected at Mr. Bishop's observatory during the last five years.

Mean Places of this Star. By M. C. Rümker.

1850.	h m s	° ′ ″
Nov. 16	1 22 54·02	+2 6 22·0
26	54·19	23·1

**Change of Colour in a Fixed Star.* By Mr. J. R. Hind.

"With the single exception of a somewhat doubtful alteration in the appearance of *Sirius*, I am not aware that there exists any mention of a decided *change* of colour in a fixed star. I am able to supply one from my own observations during the last two years of stars lying near the ecliptic. On September 3, 1848, one of a '*very red*' colour was entered on a chart in right ascension, $5^{h}\,34^{m}\cdot8$; north polar distance, $68^{\circ}\,54'$ for 1800; there are other

* The papers with an asterisk prefixed were in type at the time of publishing the preceding Number, but were postponed, as the publication would have been inconvenient for binding. A memoir by Mr. John Riddle is not inserted in the present Number, as it would then overrun two sheets, and incur a 4*d*. postage.

stars of a ruddy tinge in the neighbourhood. As I have repeatedly met with reddish variable stars, this object has been closely watched since the above date, but no alteration was perceived till the evening of November 14, in the present year, when I found the star decidedly *bluish*, the red tinge having vanished entirely. Perhaps it would now be most accurately described as *bluish white.* I am not able to furnish the exact position of this star, but the rough place above given will be quite near enough to ensure the observation of the right object."

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*Mr. Boreham remarks, "The star Argelander Zone 5, No. 26, does not exist."

"There is a star with a declination (1850·0) $+ 54^\circ\ 40'\ 21''\cdot 8$, which agrees with it in R.A. It is probably the same as B.A.C. 4845 = Groombridge 2138."

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*Mr. John Drew, F.R.A.S., of Southampton, has sent an extract from his observing-book, which shows very clearly that his sidereal time may be relied on to a small portion of a second. Mr. Drew has replaced his original transit by a transit-circle, which, however, as yet has only been employed in observing right ascensions.

Mr. Stebbing, who has charge of the chronometers of the steamboats from Southampton, has taken Mr. Drew's transit, and proposes to find the rates and errors of his chronometers by astronomical observations.†

On the Influence exerted by Heat upon the Dispersive and Refractive Power of Liquids. Preliminary Observations. By Rev. T. Pelham Dale.

This paper contains a numerical statement of the values found by the use of Professor Powell's apparatus (formerly employed for the determination of values communicated by Professor Powell to the British Association, and now lent by him to Mr. Dale), for the indices of refraction of Fraunhofer's lines, B, C, D, E, F, G, H, in distilled water, alcohol, Fusel oil, pyroxalic spirit, and bisulphuret of carbon, at temperatures ranging (for the most part) from 10° to 35° centigrade.

It does not appear that similar measures have been made before these.

The author describes in detail the method of using the apparatus. He remarks, however, that though the change of refractive index in general is obtained with great accuracy, the charge of irrationality can hardly be deduced from these measures.

† It is to be hoped that this example will be followed. Accidents at sea, owing to bad chronometers or imperfect compasses, *ought* to be reckoned with things that *have* been. There *need* not be any casualties arising from such causes.

Mr. Cullimore remarks that, on comparing the distances of the moon and of the external satellites of *Jupiter* and *Saturn* with the distance of each planet respectively from the sun, the ratio is nearly the same, *i.e.* about 1 : 400. This remarkable analogy leads him to suspect that the law may be more general, and that it would be worth while to look for an exterior satellite of *Uranus* and of *Neptune* at the same relative distance.

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*Letter from the Rev. W. Read, Vicarage, South Mimms.

"On Wednesday the 4th of September, about half-past nine A.M., while engaged in adjusting my equatoreal for observing the planet *Mercury*, I was much surprised to find great numbers of self-luminous bodies traverse the field of view of the telescope.

"They passed with different velocities, some slowly, and others with great rapidity; possessing apparently about the brightness of *Venus*, with which I compared them; and with discs all perfectly round and well defined.

"They appeared to occupy a zone several degrees in breadth, the centre of which was about 44° altitude. Their size was extremely varied, from about 2″ or even less, to about 20″, and a few much larger, which seemed to move with less velocity than the others, and had, perhaps, not quite so great brilliancy.

"The direction they took, principally, was from due east to west; but many passed at angles a little differing therefrom, while some took a direction from north to south; but I believe none in the contrary order.

"I continued to observe them at intervals, for about six hours, during which period there was scarcely any cessation; sometimes crowding through the field of view so numerously as not to permit them to be counted.

"The number which passed must have been inconceivably great; as, though the telescope was moved through a zone of several degrees in breadth, they appeared equally numerous; but if there were any perceptible difference, they seemed to be rather more frequent in the immediate vicinity of the equator.

"There were very few shooting stars at night; and I only noticed one, during a long and attentive observation on the day following.

"They readily bore a magnifying power; and where a high one was applied, no spots or variable brightness in the discs of even the largest were discernible.

"They appeared self-luminous; as when viewed even near the sun, they still retained their perfect round form, without gibbosity or crescent shape.

"I may mention that the telescope employed is one of Dollond's, 2¾ inches aperture, 3½ feet focal length, and admirable in its performance. I counted many hundreds, though the field of view was so small." †

† May not these appearances be attributed to an abnormal state of the optic nerves of the observer? *Editor.*

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ROYAL ASTRONOMICAL SOCIETY.

VOL. XI. *January* 10, 1851. No. 3.

Rev. R. SHEEPSHANKS, Vice-President, in the Chair.

E. F. T. Fergusson, Esq., Indian Navy;
Isaac Brown, Esq., Ackworth, near Wakefield; and
William Simms, junior, Esq., 138 Fleet Street,
were balloted for and duly elected Fellows of the Society.

Astronomische Nachrichten.

The Fellows of the Royal Astronomical Society will be gratified to learn that the publication of the *Astronomische Nachrichten* is continued under the care of Professor Hansen and Dr. Petersen. The loss of the lamented Professor Schumacher could not be more satisfactorily supplied than by the new editors; and we may, perhaps, be allowed to urge it as a duty on all lovers of the science, liberally to support the undertaking by communications and otherwise.

Newly discovered Inner Dark Ring of Saturn.

The editor of the *Monthly Notices* calls attention to the following important errors at pp. 23 and 24 of the number for last December.

At page 23, 3 lines from the bottom, should be inserted, [" Here follows a diagram illustrating the appearances."] This passage was omitted by the compositor, as the signs [ ] are the usual mode of directing the printer to leave out the matter inclosed; and *as the diagram was not appended,* the editor overlooked the omission.

The unfortunate absence of this sketch caused the editor to misunderstand the true import of that part of Mr. Dawes' journal which refers to the appearance of *Saturn* on Nov. 29. With the sketch, which is nearly identical with the right-hand half of the wood-engraving, it would have been self-evident from the journal that Mr. Dawes saw on Nov. 29, and even on Nov. 25, pretty much the same phenomena as were visible to him and to Mr. Lassell at later dates. The note p. 18 is incorrect in not calling attention to this fact.

Again, at p. 24, line 9, after Mr. Lassell's description that the space between the inner ring and the ball appeared as if a crape veil had been thrown over half of it, the next sentence in the *proof* and *manuscript* was as follows:—" From *c* to *d* a little shaded off, and from *d* to the commencement of *b* was of uniform grey colour, whilst *b* was as black as any part of the sky, or as the shadow of the ball on the following side of the ring." As there were no letters to the woodcut, the editor added the following foot-note to the *proof:*

" *c* is the dark inner edge of the bright ring, which shades off a little to *d*; the dark ring is then of a uniform grey colour: *b* is the sky seen between Bond's ring and the planet."

Unluckily the printer mistook the direction, and *replaced* Mr. Lassell's *text* by the editor's *note*. In the *revise* the latter passage was directed to be made a note, *but the loss of Mr. Lassell's original passage was not perceived.* Finally, in the last and very hurried revision, an hour before going to press, when the original manuscript was not at hand, it was perceived that the note had nothing to refer to, and the text was formed as it stands at present, omitting, what ought to have been stated, that the words used were the editor's explanation by means of the woodcut, of what he understood by Mr. Lassell's description. The *lost* passage and *note* should be inserted instead of the words, " There is a dark inner edge . . . . between Bond's ring and the planet."

Extract from a Letter received from Mr. Dawes.

" I regret to find that, in some quarters, the extent of my claim to the *independent discovery* of a new appendage to *Saturn's* ring, founded on my observations of Nov. 29, 1850, does not appear to be correctly appreciated;* and it has been urged upon me to state in a connected form what I considered to have been established by the observations of that evening.

" It must be acknowledged that rough original entries, made in the utmost haste under the fear of losing the precious starlight, and of disordering the optic nerve by long or frequent exposure to the light of the lamp, do not always fully express what the observer intended to convey; and sometimes it is not easy to do so, even by the utmost care in the description, without an illustrative picture. I was aware that my original records on the evening in question required such assistance, especially as the phenomena were at first made out and recorded *separately*. I therefore drew a large coarse diagram in my journal in immediate connexion with the entries;

* In giving an account of what he saw at Wateringbury in company with Mr. Dawes, Mr. Lassell confined himself to describing his own impressions, well knowing that Mr. Dawes would himself communicate his series of observations, which were, therefore, not alluded to. The mistake of the Editor, which has probably misled other persons, arose from the simple circumstance that Mr. Lassell sent a drawing of what he saw on Dec. 3d, and was therefore understood, and that Mr. Dawes relying on the verbal description of what he saw on Nov. 29, was not clearly understood in consequence of omitting his sketch.

and, taken together, they pretty distinctly show the extent of my discovery on that night. This was,—

"A dull, slightly reflective, zone, appearing as if illuminated by twilight, or like a very dull, unreflective portion of the moon, when the sun shines upon it *very* obliquely; extending towards the ball from a dark shaded boundary at the inner edge of the bright ring, to a distance about equal to the inner portion (or rather more than two-thirds of the breadth) of the outer ring; and seen projected upon the ball as a narrow dark line of elliptic form. This zone I considered to be a continuation of the breadth of the inner ring; the dark boundary between them not suggesting the idea of a complete *separation.*

"As no important addition was made to the discoveries of Nov. 29, up to the time of sending my paper to the Society, the woodcut appended to that paper may be taken as representing my original diagram in all essential points, when *corrected* by the following remarks upon it.

"The principal points it was intended to illustrate were, the position and comparative visibility of the division in the outer ring; and the situation and breadth of the obscure zone, with its narrow projection where it crosses the ball. The former is well shown; but the obscure zone is made *much too broad.* In my description it is stated to be about the breadth of the inner portion of the outer ring, and to appear like a very faint continuation of the breadth of the inner ring, occupying about *four-tenths* of the interval between the interior boundary of the bright part of the ring and the edge of the ball. In the engraving its breadth is *two-thirds* of that interval; and, consequently, the projection of the part which crosses the ball is also much too broad.

"The shadow of the ball upon the ring should be rather broader towards the bottom, and its outer edge *slightly convex* towards the ball. This convexity I have always observed of late, and depicted in my diagrams; though I am unable to account for the appearance, as the extreme thinness of the ring does not seem to allow of sufficient convexity of its surface to produce the effect. Perhaps it is only the effect of *contrast* with the much greater curvature of the edge of the ball.

"The belts on the ball are nearly in their right situation, but are, of course, far too strong and distinct. They have lately been only slightly distinguished from the general duskiness of the planet's southern hemisphere; but a wood-engraving cannot be expected accurately to represent shadings so delicate; and, consequently, the gradual shading off of the inner portion of the bright ring is not attempted."

Further Observations of the Ring of Saturn. By the Rev. W. R. Dawes.

"I have frequently received the impression of the newly-discovered obscure ring being divided into two, or else composed of two

zones of different reflective power; the inner one possessing the least, and being also much narrower than the other. That nearest the bright ring has been repeatedly seen *in twilight*, extending to about *one-third* of the interval between the bright ring and the ball; its outer and inner edges presenting an elliptic curve pretty well defined for so faint an object. As the twilight faded, another, interior, and narrower zone has appeared, having also a well-defined elliptic inner edge; an extremely narrow dark boundary, or division, lying between the two. When the obscure ring, taken as a whole, appears broadest, it is not of *uniform* brightness, the outer portion being the brighter: and in ordinary states of the air, this outer portion alone is visible; while, during occasional fits of better vision, and on very fine nights, the inner portion also is seen.

"Supposing that, according to Struve's measures, the interval between the ball and the interior bright ring is 4''·34, I should estimate the breadth of the different portions nearly as follows:—

Dark boundary, or interval, between bright ring and exterior obscure ring..	''0·3
Breadth of the exterior obscure ring	1·1
Breadth of interior obscure ring and dark boundary between the two	0·6
	2·0
Interval between inner edge and the ball	2·34

"On the whole, the idea of two rings appears more probable than that of two zones of different reflective power on the same ring; since, in the latter case, the inner edge of the exterior one would be unlikely to present a well-defined elliptic outline.

"Micrometrical measurements of the breadth of the obscure ring have been repeatedly attempted; but the difficulty of the observation is extreme. The results are the following, reduced to the mean distance of *Saturn*. They include the whole space from the inner edge of the bright ring to the inner edge of the obscure ring when most perfectly seen. Power employed on each occasion 375.

1850.	Dec. 20	''1·807	by 6	observations.	Weight	6
	22	1·967	— 6	—	—	10
1851.	Jan. 23	1·958	— 10	—	—	32
Mean, allowing weights	=	1·941	— 22	—	—	48

"I have always observed, that the upper and more distant portion of the obscure ring is more plainly seen than the corresponding portion on the side nearest to the earth; and also that the projection of it at its inner axis is considerably narrower than accords with its breadth at the major axis."

Extract of a Letter from Father Secchi, Director of the Observatory of the Collegio Romano, to the Astronomer Royal.

"January 15, 1851.

"We have calculated the elements of *Egeria*, by Professor

Challis's method, using the Naples observations of November 8th, 15th, and 22d, made by M. de Gasparis, the results which follow can only be regarded as a rough approximation.

Epoch, November 15·0, 1850, Greenwich Mean Time.

	° ′ ″	
Mean Anomaly	293 38 14·25	
Long. of Perihelion	114 35 11·5	Mean Eq^x.
Ascending Node................	43 46 33·86	January 1850.
Inclination	15 35 53·80	
Mean Diurnal Motion	872″·401169	
Semi-axis Major.................	2·547967	
Excentricity	0·09667279	
Sidereal Period	4^{yrs}·0671539	

"We have applied the corrections for aberration and parallax, nutation and precession. The middle observation is exactly represented; the extremes are also exactly represented in right ascension, but in declination there is a difference for the first of +3″·5, and in the last of −3″·1, which seems to indicate a correction to be made in the inclination and node. As soon as we have new observations these elements will be corrected.

Saturn's Ring.—"I observed on the evening of the 23d of November, 1850, that the shadow of the ball on the ring was slightly curved, its convexity being opposed to the ball. The inner edge of the planet seemed to me also exceedingly ill defined, and I supposed both phenomena to be due to a convexity in the surface of the ring. I wrote about this subject to Mr. Lassell, who answered that he too had seen the shadow so curved, and also a kind of crape veil, or shade in the inside of the inner ring, which seems to extend in a dark thin line before the planet, where it is crossed by the ring. This is exactly what I, too, have seen since the indication of Mr. Lassell, who with his powerful telescope could see clearly what we could only see in a confused manner.* There is, therefore, something new in this marvellous planet, but I need say no more since you will have better information from Mr. Lassell himself."

At the close of the meeting, Sir John Lubbock favoured the Society with some remarks on the properties and uses of the *Gnomonic Projection of the Sphere.*

The especial view of this lecture was to point out the facility with which, by means of maps drawn upon this projection, the solution of problems in what is called "the use of the globes" may be accomplished.†

* The observations of MM. Dawes and Lassell on the novel appendage to *Saturn*, were made at Wateringbury with Mr. Dawes' refractor of 6¼ inches aperture, the workmanship of Merz, of Munich.

† A *demonstration of the* rules for performing these operations will be found

As the circles of the sphere in this projection are laid down according to their perspective representations, as viewed from the eye placed at the centre of the sphere, it is necessary to bear in mind the rules by which accurate projections upon a given plane of any original lines are procured.

Having recapitulated these rules, the author pointed out how any great circle can be graduated, and how a great circle can be drawn making any given angle with another.

Problems connected with the rising and setting of stars and the like, depend upon finding the horizon. This is easily accomplished by ascertaining, from the sidereal time and the latitude of the place, the cardinal points; and a straight line joining any two of them represents the horizon. The method of laying down the vertical circles was explained.

The author also remarked that, by means of the rules of perspective, not only the projection of any given circle upon any given plane may be drawn, but conversely, the original circle of which any given conic section may be the projection, can be determined.

It was shown how, by means of this principle, a general method was furnished of constructing by points any given conic section, and of drawing tangents to it from points either situated or not upon the curve.

VICTORIA.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1851.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	Star of Comparison.
Jan. 12	6 51 20·7	0 36 0·83	+8·186	83 3 48·6	−9·8614	δ Piscium
	7 21 18·2	2·75	·302	43·0	·8638	—
22	8 24 21·3	51 10·99	·501	82 2 10·4	·8695	ε Piscium
	8 54 18·7	12·89	·540	6·1	·8748	—
23	7 44 30·9	0 52 40·80	·434	81 55 52·6	·8630	δ Piscium
	8 4 29·4	42·12	+8·472	46·0	−9·8661	—

Where P is the equatoreal horizontal parallax, p and q the corrections for parallax in time and arc respectively.

The assumed *mean* places of the stars of comparison for 1851·0, are derived from the Greenwich 12-year Catalogue.

	R.A. h m s	N.P.D. ° ′ ″
δ Piscium	0 40 57·29	83 13 36·56
ε —	0 55 12·86	82 54 47·81

in Sir John Lubbock's tract *On the Gnomonic Projection of the Sphere:* small maps of the earth and of the heavens on the gnomonic projection may be procured at No. 6 Charing Cross for 1*d.* each. Sir John states that he can solve *problems on these maps* as exactly as by a 12-inch globe.

DURHAM. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1850.	Green. M.T. h m s	App. R.A. h m s	App N.P.D. ° ′ ″	No. of Comps. R.A.	N.P.D.	Set.
Nov. 2	10 18 52·4	23 24 17·99	83 57 37·2	24	8	20
4	10 47 37·5	24 55·47	84 10 8·7	8	8	21
5	8 2 42·5	25 14·09	15 19·8	24	8	22
8	9 36 40·8	26 29·43	31 45·3	11	4	23
12	11 11 37·9	28 32·64	50 0·1	24	8	24
	12 0 12·4	33·67	4·7	18	6	25
14	7 17 47·7	29 36·96	84 57 0·1	14	8	26
16	8 23 6·2	30 53·90	85 3 45·8	23	8	27
21	8 32 27·2	34 28·87	16 21·9	24	8	28
27	10 16 21·2	39 33·50	24 9·3	12	6	29
28	9 59 6·9	23 40 26·84	85 24 41·5	23	8	30

Assumed *Apparent* Places of Stars of Comparison.

Name.	App. R.A. h m s	App. N.P.D. ° ′ ″	Set.
Weisse, xxiii. No. 594	23 28 39·69	83 57 44·4	20
— — 458	22 46·73	84 23 42·6	21
B.A.C. 8177, Greenwich 12-year Cat.	20 24·07	26 20·6	22
— — — — —	20 24·04	26 20·7	23
Weisse, xxiii. No. 602	29 12·37	54 26·0	24
— — 534	26 16·05	51 26·5	25
— — 602	29 12·35	84 54 26·1	26
ι Piscium. From the Naut. Alm.	32 16·58	85 10 52·7	27
— —	32 16·53	10 52·9	28
Weisse, xxiii. No. 803	39 24·67	34 40·9	29
— — —	23 39 24·66	85 34 41·0	30

The observations have been corrected for refraction, and for parallax by M. Yvon Villarceau's ephemeris.

Nov. 2. Wind so loud that no observations could be taken till the planet had passed the meridian.

Nov. 4. Wind extremely boisterous. The hearing tube used throughout, but the beats frequently drowned by the roaring.

Nov. 5. Windy. The differences turned out better than expected.

Nov. 8. Not a favourable observation: troubled by wind and haze, principally by the latter.

Nov. 12. The sky recently cleared.

Nov. 14. The planet dim from moonlight entering the field.

Nov. 27. Planet and star in a difficult position. Right ascension and north polar distance measures taken separately. Some suspicion about the setting of the wire-frame on this occasion.

Nov. 28. Planet better seen than on the 27th. Observation was discontinued after this date, as the measures were found to be losing the requisite precision.

"Since the publication of M. Villarceau's ephemeris, I have applied the corrections for parallax to my former observations, and I subjoin a list of the resulting differences between the observed and computed places. I have altered the assumed place of one star only, that of set 10, taking it in preference from the Greenwich 12-year Catalogue. An error of one revolution of the micrometer (20″·0) has also been corrected. One revolution is assumed to be =20″·000 −0″·0020 *(T−45° Fahr.)*.

Excesses of the Ephemeris over Observation.

Set.	R.A.	N.P.D.	Set.	R.A.	N.P.D.	Set.	R.A.	N.P.D.
	s	"		s	"		s	"
1	+0·01	−0·1	11	+0·12	−3·5	21	−0·33	+2·6
2	+0·19	+1·0	12	0·00	+0·4	22	−0·27	+2·0
3	−0·39	+1·2	13	−0·07	+1·5	23	−0·64	+2·8
4	−0·30	+2·0	14	+0·36	+2·9	24	−0·54	+4·7
5	+0·13	+3·3	15	−0·35	+1·1	25	−0·44	+8·2
6	+0·09	+0·8	16	−0·64	+2·5	26	−0·63	+1·7
7	+0·42	−1·3	17	+0·15	+0·6	27	−0·12	+3·9
8	+0·32	−2·8	18	+0·31	+0·3	28	−0·58	+2·1
9	+0·36	−0·9	19	+0·50	−0·5	29	−1·17	+5·2
10	+0·36	−3·2	20	−0·31	+3·2	30	−0·81	+5·6

" Assuming that these excesses may be represented generally by the formula,

$$E = A + B \,.\, t + C \,.\, t^2,$$

the values of A, B, and C, have been computed by the formulæ given by the principle of minimum squares, and the results are,

$$\text{Excess in R.A.} = +0''\!\cdot\!688 + 0''\!\cdot\!2102 \,.\, t - 0''\!\cdot\!00598 \,.\, t^2$$

$$\text{N.P.D.} = +0\cdot020 - 0\cdot0336 \,.\, t + 0\cdot00166 \,.\, t^2$$

t being reckoned in mean days from September 20·0.

" For every ten days these expressions give,

	Calcul[d]—Observ[d]. R.A.	N.P.D.		Calcul[d]—Observ[d]. R.A.	N.P.D.
	s	"		s	"
Sept. 20	+0·046	+0·02	Oct. 30	−0·031	+1·33
30	+0·146	−0·15	Nov. 9	−0·250	+2·49
Oct. 10	+0·167	+0·01	19	−0·549	+3·98
20	+0·107	+0·50	29	−0·927	+5·80

which must be considered the results of the Durham observations for this opposition. We depend entirely on others for the re-observation of the stars of comparison, by far the greater number being too small for the Durham transit circle."

MARKREE. Mer. Circle. (E. J. Cooper, Esq., and A. Graham.)

1850.	Green. M.T.	R.A.	Decl.	No. Wires.	Obs[d]—Calc[d] R.A.	Decl.
	d	h m s	° ' "		s	"
Sept.	17·520081	23 41 24·62	+13 31 11·0	5	−0·15	+1·9
	21·506906	38 9·39	12 52 21·3	3	−0·48	+2·2
	23·500352	36 34·70	12 31 47·8	5	−0·46	−1·7
	24·497087	35 48·41	12 21 20·1	5	−0·32	−1·2
Oct.	1·474513	30 48·60	11 5 14·7	3	−0·56	−0·9
Dec.	7·304379	49 17·79	4 39 2·7	5	+0·29	+6·0
	13·292639	23 56 0·01	4 49 39·6	5	+0·41	+7·5
	21·277517	0 5 42·51	+5 12 32·0	5	+0·51	+5·9

" Corrected for parallax by Villarceau's ephemeris, *Comptes Rendus*, vol. xxxi. p. 681: the two last columns give the comparison between the observed places and those interpolated from Villarceau's ephemeris."

Sept. 17. Good observation.
Dec. 7. Good observation.
Dec. 13. Very faint.

The following *apparent* places of stars which were either observed by mistake for *Victoria* and *Egeria*, or observed at the same time, may be useful to extra-meridian observers:—

1850.		R.A. h m s	Decl. ° ′ ″
Sept. 30		23 31 19·80	+ 11 22 12·9
Oct. 4		23 28 58·12	10 41 49·6
9		23 25 28·47	9 32 48·1
Dec. 21	9 mag.	0 4 42·09	5 11 59·3
—		1 33 0·59	11 0 13·3
1851. Jan. 8		1 39 58·47	+ 13 8 20·2

Elements.

By Dr. B. A. Gould of Cambridge, U.S., from two Normal Places, and an Observation at Washington on December 20th.

Epoch, 1851, Jan. 0·0, Berlin Mean Time.

	° ′ ″	
Mean Anomaly	65 47 23·0	
Ascending Node............	235 29 49·8	Mean Equinox.
$\varpi - \Omega$	66 25 22·2	
i	8 23 1·9	
φ	12 35 46·9	
μ	16′ 34″·715	
Log a	0·3682053	
Log e	9·3386184	
Log μ	2·9976987	
Period	1302$^{\text{days}}$·88	Sidereal.

Ephemeris. By M. Yvon Villarceau.

For Paris Mean Noon.

1851.	R.A. h m s	Decl. ° ′ ″	Log Δ.	1851.	R.A. h m s	Decl. ° ′ ″	Log Δ.
Jan. 1	0 19 52·95	+ 5 56 28·0	0·31519	Jan. 16	0 41 31·01	+ 7 18 2·1	0·35904
2	21 15·94	+ 6 1 15·1	·31826	17	43 1·15	24 7·0	·36179
3	22 39·48	6 8·5	·32131	18	44 31·69	30 15·9	·36452
4	24 3·97	11 7·9	·32434	19	46 2·62	36 28·6	·36723
5	25 28·20	16 13·4	·32735	20	47 33·93	42 45·0	·36992
6	26 53·35	21 24·6	·33034	21	49 5·62	49 5·2	·37258
7	28 19·01	26 41·5	·33330	22	50 37·68	+ 7 55 28·7	·37523
8	29 45·17	32 3·9	·33625	23	52 10·11	+ 8 1 55·6	·37785
9	31 11·82	37 31·7	·33917	24	53 42·89	8 25·8	·38046
10	32 38·94	43 4·6	·34208	25	55 16·04	14 59·0	·38304
11	34 6·51	48 42·6	·34496	26	56 49·53	21 35·3	·38560
12	35 34·55	+ 6 54 25·4	·34782	27	58 23·37	28 14·5	·38815
13	37 3·02	+ 7 0 12·9	·35065	28	0 59 57·56	34 56·6	·39067
14	38 31·93	6 4·9	·35347	29	1 1 32·07	41 41·3	·39317
15	0 40 1·26	+ 7 12 1·4	0·35626	30	1 3 6·92	+ 8 48 28·6	0·395[illegible]

1851.	R.A. h m s	Decl. ° ′ ″	Log Δ.
Jan. 31	1 4 42·09	+ 8 55 18·3	0·39810
Feb. 1	6 17·58	+ 9 2 10·4	·40054
2	7 53·38	9 4·7	·40295
3	9 29·49	16 1·1	·40535
4	11 5·90	22 59·6	·40772
5	12 42·59	29 59·8	·41007
6	14 19·58	37 1·8	·41240
7	15 56·84	44 5·5	·41471
8	17 34·38	51 10·8	·41700
9	19 12·18	+ 9 58 17·4	·41927
10	20 50·25	+ 10 5 25·3	·42152
11	22 28·56	12 34·4	·42374
12	24 7·13	19 44·5	·42595
13	25 45·95	26 55·6	·42813
14	27 25·00	34 7·6	·43030
15	29 4·30	41 20·3	·43244
16	30 43·83	48 33·7	·43457
17	32 23·58	+ 10 55 47·6	·43667
18	34 3·57	+ 11 3 2·0	·43875
19	35 43·78	10 16·8	·44082
20	37 24·22	17 31·9	·44287
21	39 4·88	24 47·2	·44489
22	40 45·77	32 2·6	·44690
23	42 26·87	39 18·1	·44888
24	44 8·20	46 33·6	·45085
25	45 49·74	+ 11 53 48·9	·45279
26	47 31·49	+ 12 1 4·1	·45472
27	49 13·45	8 19·0	·45663
28	50 55·62	15 33·5	·45852
Mar. 1	52 37·99	22 47·5	·46038
2	1 54 20·55	+ 12 30 1·0	0·46223

1851.	R.A. h m s	Decl. ° ′ ″	Log Δ.
Mar. 3	1 56 3·32	+ 12 37 13·9	0·46406
4	57 46·28	44 26·2	·46587
5	1 59 29·43	51 37·6	·46766
6	2 1 12·76	+ 12 58 48·2	·46943
7	2 56·27	+ 13 5 57·7	·47118
8	4 39·96	13 6·3	·47291
9	6 23·82	20 13·7	·47463
10	8 7·85	27 19·8	·47632
11	9 52·04	34 24·6	·47800
12	11 36·39	41 28·1	·47965
13	13 20·90	48 30·1	·48129
14	15 5·57	+ 13 55 30·5	·48290
15	16 50·39	+ 14 2 29·3	·48450
16	18 35·35	9 26·4	·48608
17	20 20·46	16 21·8	·48765
18	22 5·73	23 15·4	·48919
19	23 51·14	30 7·0	·49072
20	25 36·70	36 56·8	·49222
21	27 22·40	43 44·6	·49371
22	29 8·25	50 30·2	·49518
23	30 54·24	+ 14 57 13·7	·49663
24	32 40·37	+ 15 3 55·1	·49807
25	34 26·64	10 34·2	·49949
26	36 13·05	17 11·0	·50088
27	37 59·59	23 45·5	·50226
28	39 46·28	30 17·5	·50363
29	41 33·09	36 47·1	·50497
30	43 20·03	43 14·1	·50630
31	45 7·10	49 38·6	·50761
April 1	2 46 54·29	+ 15 56 0·4	0·50890

"This ephemeris is a continuation of that published by M. Villarceau in the *Comptes Rendus*, vol. xxxi. pp. 681, 2, and is calculated from the elements at p. 680."

FLORA.

Durham. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1850.	Greenwich M.T. h m s	App. R.A. h m s	App. N.P.D. ° ′ ″	No. of Comps. R.A.	No. of Comps. N.P.D.	Set.
Nov. 5	10 15 22·3	23 58 41·80	101 30 14·2	24	8	7
	11 0 41·0	42·01	4·2	23	8	8
8	11 37 4·0	23 58 59·96	101 13 40·8	9	3	9
21	*11 24 17·8*	0 3 51·22	99 38 5·1	7	3	10

Assumed *Apparent* Places of Stars of Comparison.

Set.	Name.	R.A. h m s	N.P.D. ° ′ ″
7	B.A.C. 8361	23 56 51·85	101 20 23·7
8	Weisse, xxiii. 1232	23 59 54·37	101 32 0·3
9	B.A.C. 8361	23 56 51·83	101 20 24·0
10	Weisse, xxiii. 1249	0 0 40·66	99 39 15·6

Nov. 5, very windy.
Nov. 8, state of the atmosphere very unfavourable.'
Nov. 21, very hazy. The planet sunk down into a bank of fog.

MARKREE. Mer. Circle. (E. J. Cooper, Esq., and A. Graham.)

1850.	Green. M.T. d	R.A. h m s	Decl. ° ′ ″	No. Wires.	Obs^d—Calc^d R.A. s	Obs^d—Calc^d Decl. ″
Oct.	9·479411	0 9 25·36	−11 51 55·4	5	−2·94	−16·4

"Corrected for parallax and interpolated from the *Nautical Almanac.*"

EGERIA.

MARKREE. Mer. Circle. (E. J. Cooper, Esq., and A. Graham.)

1851.	Green. M.T. d	R.A. h m s	Decl. ° ′ ″	No. Wires.	Obs^d—Calc^d R.A s	Obs^d—Calc^d Decl. ″
Jan.	13·281945	1 42 46·91	+13 47 3·9	5	−1·05	−0·2

"Corrected for parallax and compared place computed from G. Rümker's Ephemeris, *Monthly Notices*, vol. xi. p. 34. *Egeria* very faint."

HAMBURG. Equatoreal. (M. C. Rümker.)

1850.	Hamburg M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″	Obs.
Dec. 16	8 21 33·8	23 13 38·4	+10 30 30·1	28
17	5 45 8·6	23 13 14·0	10 35 35·6	7
26	6 52 39·5	23 27 27·6	11 31 38·8	15
31	7 5 40·9	23 49 49·5	12 5 46·5	28
1851. Jan. 22	8 4 30·8	27 17 3·1	14 58 6·1	13
28	7 11 54·8	28 39 19·6	15 49 10·9	4
31	7 55 37·6	29 24 55·2	16 16 3·2	5
Feb. 1	7 18 22·7	29 40 10·0	+16 24 37·2	31

Mean Places of the Compared Stars for Jan. 0, 1851, deduced from Observations with the Meridian Circle at Hamburg.

R.A. h m s	Obs.	Decl. ° ′ ″	Obs.	R.A. h m s	Obs.	Decl. ° ′ ″	Obs.
1 29 12·26	4	+11 22 40·1	4	1 46 17·54	2	+ 8 51 51·0	3
29 45·32	4	11 18 59·9	4	46 31·40	3	8 48	
30 14·36	1	12 5 9·2	1	46 57·06	2	8 27 27·6	2
34 18·66	2	10 35 48·8	2	50 34·04	1	15 12 9·2	1
35 13·11	2	12 9 9·3	1	52 27·04	1	8 39 43·1	1
35 41·70	2	12 7 47·8	3	52 52·13	5	8 29 15·4	5
40 41·92	3	9 28 12·6	3	53 3·66	1	15 50 34·1	1
42 25·61	4	9 4 9·1	4	1 54 42·67	1	8 21 38·6	1
1 44 45·84	2	+ 8 50 58·3	2	2 1 12·38	1	+16 31 23·2	1

1851.	R.A. h m s	Decl. ° ′ ″	Log Δ.	1851.	R.A. h m s	Decl. ° ′ ″	Log Δ.
Jan. 31	1 4 42·09	+ 8 55 18·3	0·39810	Mar. 3	1 56 3·32	+ 12 37 13·9	0·46406
Feb. 1	6 17·58	+ 9 2 10·4	·40054	4	57 46·28	44 26·2	·46587
2	7 53·38	9 4·7	·40295	5	1 59 29·43	51 37·6	·46766
3	9 29·49	16 1·1	·40535	6	2 1 12·76	+ 12 58 48·2	·46943
4	11 5·90	22 59·6	·40772	7	2 56·27	+ 13 5 57·7	·47118
5	12 42·59	29 59·8	·41007	8	4 39·96	13 6·3	·47291
6	14 19·58	37 1·8	·41240	9	6 23·82	20 13·7	·47463
7	15 56·84	44 5·5	·41471	10	8 7·85	27 19·8	·47632
8	17 34·38	51 10·8	·41700	11	9 52·04	34 24·6	·47800
9	19 12·18	+ 9 58 17·4	·41927	12	11 36·39	41 28·1	·47965
10	20 50·25	+ 10 5 25·3	·42152	13	13 20·90	48 30·1	·48129
11	22 28·56	12 34·4	·42374	14	15 5·57	+ 13 55 30·5	·48290
12	24 7·13	19 44·5	·42595	15	16 50·39	+ 14 2 29·3	·48450
13	25 45·95	26 55·6	·42813	16	18 35·35	9 26·4	·48608
14	27 25·00	34 7·6	·43030	17	20 20·46	16 21·8	·48765
15	29 4·30	41 20·3	·43244	18	22 5·73	23 15·4	·48919
16	30 43·83	48 33·7	·43457	19	23 51·14	30 7·0	·49072
17	32 23·58	+ 10 55 47·6	·43667	20	25 36·70	36 56·8	·49222
18	34 3·57	+ 11 3 2·0	·43875	21	27 22·40	43 44·6	·49371
19	35 43·78	10 16·8	·44082	22	29 8·25	50 30·2	·49518
20	37 24·22	17 31·9	·44287	23	30 54·24	+ 14 57 13·7	·49663
21	39 4·88	24 47·2	·44489	24	32 40·37	+ 15 3 55·1	·49807
22	40 45·77	32 2·6	·44690	25	34 26·64	10 34·2	·49949
23	42 26·87	39 18·1	·44888	26	36 13·05	17 11·0	·50088
24	44 8·20	46 33·6	·45085	27	37 59·59	23 45·5	·50226
25	45 49·74	+ 11 53 48·9	·45279	28	39 46·28	30 17·5	·50363
26	47 31·49	+ 12 1 4·1	·45472	29	41 33·09	36 47·1	·50497
27	49 13·45	8 19·0	·45663	30	43 20·03	43 14·1	·50630
28	50 55·62	15 33·5	·45852	31	45 7·10	49 38·6	·50761
Mar. 1	52 37·99	22 47·5	·46038	April 1	2 46 54·29	+ 15 56 0·4	0·50890
2	1 54 20·55	+ 12 30 1·0	0·46223				

"This ephemeris is a continuation of that published by M. Villarceau in the *Comptes Rendus*, vol. xxxi. pp. 681, 2, and is calculated from the elements at p. 680."

FLORA.

Durham. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1850.	Greenwich M.T. h m s	App. R.A. h m s	App. N.P.D. ° ′ ″	No. of Comps. R.A.	N.P.D.	Set.
Nov. 5	10 15 22·3	23 58 41·80	101 30 14·2	24	8	7
	11 0 41·0	42·01	4·2	23	8	8
8	11 37 4·0	23 58 59·96	101 13 40·8	9	3	9
21	11 24 17·8	0 3 51·22	99 38 5·1	7	3	10

Assumed *Apparent* Places of Stars of Comparison.

Set.	Name.	R.A. h m s	N.P.D. ° ′ ″
7	B.A.C. 8361	23 56 51·85	101 20 23·7
8	Weisse, xxiii. 1232	23 59 54·37	101 32 0·3
9	B.A.C. 8361	23 56 51·83	101 20 24·0
10	Weisse, xxiii. 1249	0 0 40·66	99 39 15·6

Nov. 5, very windy.
Nov. 8, state of the atmosphere very unfavourable.'
Nov. 21, very hazy. The planet sunk down into a bank of fog.

MARKREE. Mer. Circle. (E. J. Cooper, Esq., and A. Graham.)

1850.	Green. M.T. d	R.A. h m s	Decl. ° ′ ″	No. Wires.	Obs^d—Calc^d R.A. s	Obs^d—Calc^d Decl. ″
Oct.	9·479411	0 9 25·36	−11 51 55·4	5	−2·94	−16·4

"Corrected for parallax and interpolated from the *Nautical Almanac.*"

EGERIA.

MARKREE. Mer. Circle. (E. J. Cooper, Esq., and A. Graham.)

1851.	Green. M.T. d	R.A. h m s	Decl. ° ′ ″	No. Wires.	Obs^d—Calc^d R.A s	Obs^d—Calc^d Decl. ″
Jan.	13·281945	1 42 46·91	+13 47 3·9	5	−1·05	−0·2

"Corrected for parallax and compared place computed from G. Rümker's Ephemeris, *Monthly Notices*, vol. xi. p. 34. *Egeria* very faint."

HAMBURG. Equatoreal. (M. C. Rümker.)

	Hamburg M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″	Obs.
1850. Dec. 16	8 21 33·8	23 13 38·4	+10 30 30·1	28
17	5 45 8·6	23 13 14·0	10 35 35·6	7
26	6 52 39·5	23 27 27·6	11 31 38·8	15
31	7 5 40·9	23 49 49·5	12 5 46·5	28
1851. Jan. 22	8 4 30·8	27 17 3·1	14 58 6·1	13
28	7 11 54·8	28 39 19·6	15 49 10·9	4
31	7 55 37·6	29 24 55·2	16 16 3·2	5
Feb. 1	7 18 22·7	29 40 10·0	+16 24 37·2	31

Mean Places of the Compared Stars for Jan. 0, 1851, deduced from Observations with the Meridian Circle at Hamburg.

R.A. h m s	Obs.	Decl. ° ′ ″	Obs.	R.A. h m s	Obs.	Decl. ° ′ ″	Obs.
1 29 12·26	4	+11 22 40·1	4	1 46 17·54	2	+ 8 51 51·0	3
29 45·32	4	11 18 59·9	4	46 31·40	3	8 48	
30 14·36	1	12 5 9·2	1	46 57·06	2	8 27 27·6	2
34 18·66	2	10 35 48·8	2	50 34·04	1	15 12 9·2	1
35 13·11	2	12 9 9·3	1	52 27·04	1	8 39 43·1	1
35 41·70	2	12 7 47·8	3	52 52·13	5	8 29 15·4	5
40 41·92	3	9 28 12·6	3	53 3·66	1	15 50 34·1	1
42 25·61	4	9 4 9·1	4	1 54 42·67	1	8 21 38·6	1
1 44 45·84	2	+ 8 50 58·3	2	2 1 12·38	1	+16 31 23·2	1

Ephemeris. By M. G. Rümker.

For Greenwich Mean Noon.

1851.	R.A. h m s	Decl. ° ′	Log Δ.
Jan. 12	1 41 23·6	+13 34·0	0·33277
13	42 3·5	42·0	·33525
14	42 44·7	50·0	·33773
15	43 27·1	+13 58·0	·34020
16	44 10·8	+14 6·1	·34265
17	44 55·8	14·3	·34507
18	45 42·1	22·6	·34749
19	46 29·6	30·9	·34990
20	47 18·3	39·2	·35230
21	48 8·2	47·6	·35468
22	48 59·8	+14 56·0	·35705
23	49 51·5	+15 4·5	·35941
24	50 45·0	13·0	·36175
25	51 39·6	21·6	·36408
26	52 35·3	30·3	·36639
27	53 32·0	38·9	·36868
28	54 30·0	47·6	·37096
29	55 29·0	+15 56·4	·37323
30	56 29·1	+16 5·2	·37548
31	57 30·2	14·0	·37771
Feb. 1	58 32·4	22·9	·37993
2	1 59 35·7	31·8	·38213
3	2 0 39·9	40·7	·38431
4	1 45·2	49·7	·38647
5	2 2 51·5	+16 58·7	0·38862
Feb. 6	2 3 58·7	+17 7·8	0·39076
7	5 6·9	16·8	·39287
8	6 16·1	25·9	·39496
9	7 26·2	35·0	·39704
10	8 37·2	44·2	·39910
11	9 49·2	+17 53·3	·40114
12	11 2·1	+18 2·5	·40317
13	12 15·8	11·7	·40518
14	13 30·4	20·9	·40716
15	14 45·9	30·1	·40913
16	16 2·2	39·3	·41108
17	17 19·2	48·6	·41302
18	18 37·4	+18 57·8	·41494
19	19 56·3	+19 7·1	·41684
20	21 16·0	16·3	·41872
21	22 36·5	25·6	·42058
22	23 57·8	34·9	·42243
23	25 19·9	44·2	·42426
24	26 42·8	+19 53·5	·42607
25	28 6·5	+20 2·8	·42786
26	29 30·0	12·1	·42963
27	30 56·2	21·3	·43139
28	32 22·3	30·6	·43313
Mar. 1	2 33 49·0	+20 39·9	0·43485

From the Second Elements, see vol. xi. p. 32.

METIS.

Markree. Mer. Circle. (E. J. Cooper, Esq., and A. Graham.)

Greenwich M T. 1850. d	R.A. h m s	Decl. ° ′ ″	No. Wires.	Obsd—Calcd R.A. s	Obsd—Calcd Decl. ″
Dec. 11·706193	9 58 22·72	+18 55 15·0	5	−0·03	0·0
1851. Jan. 8·640815	10 1 15·34	20 43 24·1	5	+0·06	0·0
17·613244	9 56 31·85	21 42 44·6	1	+0·18	+2·4
24·590220	9 51 10·86	+22 32 10·6	4	+0·06	+3·1

"Corrected for parallax and compared places computed from Graham's *Elements*, *Monthly Notices*, vol. xi. p. 36."

Jan. 8. *Metis* much brighter than was expected.

17. Clouds.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1851.	Green. M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	Compd—Obsd R.A. s	Compd—Obsd N.P.D. ″
Feb. 1	9 13 52·1	9 43 53·65	66 33 36·5	−3·43	+5·0
	9 28 49·5	53·02	33·1	−3·42	+4·2
	9 43 46·8	52·45	28·7	−3·47	+4·5

"The parallax and computed places were deduced from the ephemeris published by the superintendent of the *Nautical Almanac.*

"The star of comparison for all the observations was ι *Leonis*. The following is the assumed *mean* place for 1851·0 derived from the Greenwich Observations for 1848.

	R.A. h m s	N.P.D. h m s
ι Leonis	9 37 23·02	65 32 32·68

SATELLITE OF NEPTUNE.

Observations.

STARFIELD. 20-foot Equatoreal. (Mr. Lassell.)

1850.	G.M.T. h m	Position. ° ′	Obs.	G.M.T. h m	Distance. ″	Obs.	
Aug. 15	11 46	40 41	5	12 24	14·65	5	(*a*)
20	12 5	23 35	2				(*b*)
Sept. 8	10 54	47 55	5	11 17	15·64	2	(*c*)
10	10 15	212 33	2				(*d*)
11	9 44	222 3	4	9 44	14·80	1	(*e*)
13	11 9	35 34	3				(*f*)
17	11 20	230 0	estim.				(*g*)
28	10 40	216 29	4	11 3	13·93	4	(*h*)
Oct. 1	9 36	40 3	2	9 12	14·92	4	(*i*)
5	9 34	230 39	3	9 9	16·58	5	(*k*)
Nov. 2	9 2	214 52	3	8 43	13·41	5	(*l*)
8	8 35	215 10	4	8 10	14·61	5	(*m*)

Remarks.

"(*a.*) Circumstances very favourable. Satellite bright and position measures taken easily. Those of distance good, but taken with less facility. Power 614.

"(*b.*) Circumstances very unfavourable. Moon full and very near. Night stormy; and these measures were obtained during a brief interval of clear sky. Power 614. Obliged to close the dome hastily by a heavy shower, which, however, gratified me with a sight of a very beautiful and perfect lunar rainbow, in which the three colours (red, orange, and blue) were very obvious.

"(*c.*) Sky very hazy. Wind easterly, and definition bad. Power 614.

"(*d.*) Atmosphere extremely unfavourable, and the satellite so faint, that no further satisfactory measures could be got.

"(*e.*) Atmosphere bad, and measures taken with great difficulty. Power 366.

"(*f.*) Sky too unfavourable to allow any measures of distance to be taken.

"(*g.*) The almost full moon in the immediate neighbourhood of the planet,

and the telescope was pointed at the object chiefly out of curiosity to ascertain whether, under the circumstances, the satellite could be seen.

"(*h.*) Satellite very bright and positions easily taken, but the sky became unfavourable while taking the measures of distance. Power 614.

"(*i.*) Bright flashing aurora, and a confused atmosphere. Measures carefully taken, but with a difficulty that might well be termed torture.

"(*k.*) Satellite extremely faint. Finding it very difficult to get measures with power 614, I tried 366, but did not see the satellite so well with this power: and, therefore, observed with the former.

"(*l.*) Sky bright occasionally, but frequently overcast. Wind strong from S.W., and blowing right into the opening of the dome, somewhat shook the telescope.

"(*m.*) Sky so hazy that, though the observations seem coincident, it was perfect torture to get them. Power 614."

Observed Differences of Japetus *and the Centre of* Saturn *in R.A. and N.P.D.* By Mr. Lassell.

1850.		G.M.T. h m			″			″
Sept.	11	10 0	Japetus	follows	467·3	Japetus	North	25·8
	12	11 20	—	—	500·4			
Oct.	5	11 0	—	—	178·0	—	—	161·2
	9	13 54	—	precedes	9·0	—	—	129·7
	10	11 30	—	—	44·5	—	—	120·4
	11	9 27	—	—	91·2	—	—	109·6
	21	8 30	—	—	453·7	—	South	19·4
	23	11 30	—	—	498·2	—	—	38·7
Nov.	2	11 0	—	—	499·9	—	—	146·2
	8	9 30	—	—	356·2	—	—	154·8
	14	8 40	—	—	112·4	—	—	137·6
	16	10 10	—	—	22·5	—	—	120·8
	21	9 20	—	follows	201·0	—	—	76·0
Dec.	11	9 30	—	—	516·0	—	North	136·5
	12	6 30	—	—	496·0	—	—	140·7
	19	6 50	—	—	296·2	—	—	142·8
	21	10 2	—	—	214·0	—	—	145·0
	24	5 10	—	—	102·2	—	—	136·5

Similar Observations of Hyperion.

1850.		h m			″			″
Sept.	17	12 36	Hyperion	follows	200·7	Hyperion	North	28·0
Oct.	5	11 30	—	—	270·0	—	South	12·0
	9	13 39	—	—	154·6	—	North	33·6
	11	10 25	—	—	22·0	—	—	40·4
Nov.	8	10 38	—	precedes	152·5	—	South	23·0
	21	9 20	—	follows	119·5	—	North	32·0

FAYE'S COMET.

CAMBRIDGE, U.S. Equatoreal. (Professor W. C. Bond.)

Cambridge M.T.				R.A.	Obs.	N.P.D.	Obs.	
1851.	h	m	s	m s		′ ″		
Jan. 1	8	3	53	a+0 12·7	(6)	a+1 16·2	(6)	
4	7	9	54	22 39 14·12	(4)	94 15 1·7	(4)	Weisse, 870

Approximate value of a, a star of the 8th magnitude.

R.A. $22^h\ 32^m\ 43^s$ N.P.D. $94^\circ\ 37'$

"The comet is a very faint object in our large equatoreal; when best seen it appeared slightly elongated in the direction of the sun."

BOND'S COMET.

The stars used at Durham (see vol. xi. No. 1) corrected.

	Mean R.A. (1850·0).	Mean N.P.D.	No. of Obs.	
	h m s	° ′ ″		
Lalande, 14384	7 17 9·02	43 10 52·0	3	Set (1)
Anonymous	7 43 15·56	50 8 9·4	2	(2)
Lalande, 15636	7 53 33·16	52 26 57·8	2	(3)

		App. R.A.	App. N.P.D.
		h m s	° ′ ″
App. Place of (1) on Sept	13	7 17 9·96	43 11 6·9
(2)	16	7 43 16·41	50 8 22·4
(3)	17	7 53 33·95	52 27 10·2

"These are meridian observations taken with the small transit circle of the Durham Observatory. Star (2) was almost too faint for the aperture of the telescope. There was an error of 1^m in its R.A. as previously assumed."

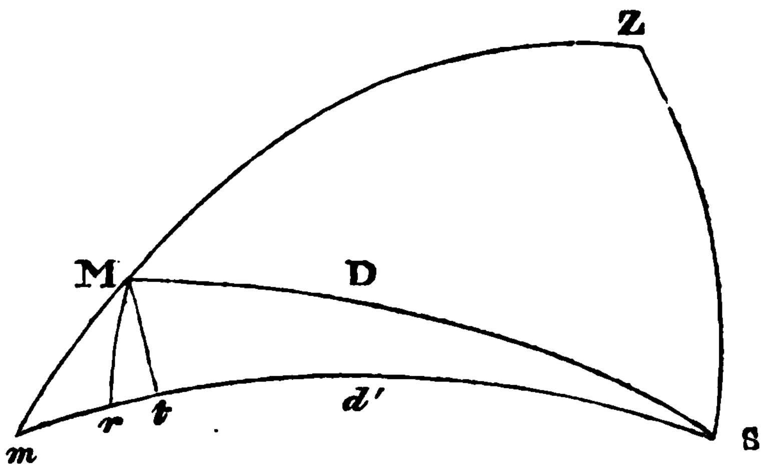
On a Method of Computing the small Corrections for clearing the Lunar Distance. By John Riddle, F.R.A.S.

"In the demonstration of this problem I have preferred to proceed by spherical trigonometry, as it enables us to see more plainly the several parts of the small differences sought for.

"As in correcting the distance separately for errors in places of the moon and of the sun or star, the formulæ for the corrections due to each object must be of precisely the same form and character, we shall suppose the effect of the parallax (when any exists) and of the refraction of the sun or star to be already allowed for (the formulæ for this purpose being given incidentally); and that it only remains to correct the observed distance for the parallax and refraction of the moon.

"Let then S be the true place of the sun or star, and M the true place of the moon, m being her apparent place, m M the correction of her altitude $= p$; then Sm is the distance between the

true place of the sun or star and the apparent place of the moon, let $= d'$, and S M the true distance sought $=$ D.



"If M t be drawn perpendicular to m S, and S r be equal to S M, then,

$$SM = Sm - mr = Sm - (mt - tr) = d' - (c_2 - c_3),$$

and thus $mt - tr$ is the correction required on account of the moon, which is to be subtracted from S m or d'.

"Now $mt = m\mathrm{M} \cos \angle m$, or representing m M by p and expressing the value of cos $\angle m$ in terms of the altitudes and distance d'

$$c_2 = p \sin a' \sec b \operatorname{cosec} d' - p \tan b \cot d' \qquad (1)$$

Where a' and b are respectively the true altitudes of the sun or star, and the apparent altitude of the moon.

"Similarly the corresponding term of the correction of the distance, on account of the sun or star, will be

$$c_1 = p' \sin b \sec a \operatorname{cosec} d - p' \tan a \cot d \qquad (2)$$

a, b, and d, being the apparent altitudes and apparent distance, and p' the correction of the sun's or star's altitude: $d + c_1 = d'$.

"The quantities c_1 and c_2 are very readily found by using p and p' in seconds; logarithms of only four places, exclusive of the characteristic, are wanted.

"The correction c_1 is in all cases sufficient on account of the sun or star, the terms corresponding to rt or c_3 being inappreciable; but the neglect of this quantity with respect to the moon, may produce an error of several seconds in the distance.

$$\text{Since } SM = Sr;\ \cos SM = \cos Sr = \cos(St + tr);$$
$$\text{and } \cos SM = \cos St \cos t\mathrm{M};$$
$$\therefore\ \cos St \cos t\mathrm{M} = \cos St \cos tr - \sin St \sin tr.$$

Substituting $1 - 2\sin^2 \frac{t\mathrm{M}}{2}$, for cos t M, and unity for the cos of the very small quantity tr, and reducing,

$$\sin tr = 2 \cot St \sin^2 \frac{t\mathrm{M}}{2}$$

Now S t is the distance corrected on account of the object at S, and once also on account of the moon; we denote it therefore by d'', and then if tr and t M be supposed to be expressed in minutes and the equation be divided by sin 1′, we have,

In minutes $t\,r$ or $c_3 = \frac{1}{2}\cot d''\,(t\,\mathrm{M})^2 \sin 1'$
In seconds $c_3 = 30 \sin 1' \cot d''\,(t\,\mathrm{M})^2$
or since $(t\,\mathrm{M})^2 = (m\,\mathrm{M})^2 - (m\,t)^2 = (p^2 - c_2{}^2)$
$c_3 = 30 \sin 1' \cot d''\,(p + c_2)\,(p - c_2),$

in which formula p and c_2 are still expressed in minutes.

"Now it so happens that $30 \sin 1' = \cdot 00873$, very nearly, and that this again differs from $\frac{1}{100} - \frac{1}{8}\,\frac{1}{100}$, by the small fraction $\frac{1}{50000}$ only; and when it is considered that the minutes in p and c_2 cannot exceed two figures each, the facility with which the value of the factors $30 \sin 1'\,(p + c_2)\,(p - c_2)$ can be computed, may be readily imagined. If we call this last quantity q;

$$c_3 = q \cot d'',$$

and the entire correction on the moon's account is,

$$c_2 - c_3 = \{p \,.\, \sin a' \sec b \operatorname{cosec} d' - p \tan b \cot d'\} - q \cot d'',$$

which is to be subtracted from d' to give D.

Example.

		°	′	″	
a =	☉'s App. Alt.	24	40	0	
	Correction		1	56	= 116″ = p'
a' =	☉'s True Alt.	24	38	4	
b =	☽'s App. Alt.	16	53	0	
	Correction		49	28	= 2968 = p
d =	App. Dist.	111	27	1	

c_1

log p'	= 2·0645	− log p	= −2·0645
l sin b	9·4630		
l sec a	0·0416	l tan	9·6620
l cosec d	0·0312	l cotan	−9·5943
	1·6003		+ 1·3208

Nat. Num. = + 39″·8
+ 20·9
60·7 = c_1 = 1′ 0″·7

c_2

log p	= 3·4725	− log p	= −3·4725
l sin a'	9·6199		
l sec b	0·0191	l tan	9·4822
l cosec d'	0·0312	l cotan	−9·5946
	3·1427		+ 2·5493

Nat. Num. = 1389″
+ 354·2
29′ 3″·2 = 1743·2 = c_2

c_3

	°	′	″
d =	111	27	1
$+c_1$		+ 1	0·7
d' =	111	28	1·7
$-c_2$		− 29	3·2
d'' =	110	58	58·5
$+c_3$			− 5·3
D =	110	58	53·2 True Distance.

p =	49′
c_2 =	29
Sum	78
Diff.	20
·01 × Prod. =	15″·6
− $\frac{1}{8}$ =	−1 ·9
	13 ·7

log = 0·137
l cot d'' −9·583
log c_3 = −9·720, c_3 = −5″·3

"The result of a very careful computation by the direct trigonometrical process, using Taylor's logarithms to seven places, is $110^\circ 58' 53''$.

Examples.

App. Alt. Sun or Star.	Corr. Sun or Star.	App. Alt. of Moon.	Corr. of Moon's Alt.	App. Dist.	True Dist. by Method above.	True Dist. by Spherics.
° ′	′ ″	° ′	′ ″	° ′ ″	° ′ ″	° ′ ″
27 43	1 51	48 22	38 0	81 23 38	81 4 39·9	81 4 39·8
7 48	6 30	35 45	42 50	95 49 12	95 42 50·4	95 42 50·4
31 38	1 24	68 50	20 24	37 23 23	37 44 55·3	37 44 55
37 40	1 14	6 25	46 56	50 27 36	49 54 7·2	49 54 7·6

"On the foregoing table I would observe that the true distances in the last column are worked with great care by Taylor's logarithms to seven places, and that tenths of seconds are accounted for. In practice, this, of course, is never done; but the result shows that the closer the computation by the direct process, the better appears the agreement with the simple method here proposed.

"In conclusion, the expressions for c_1 and c_2 may be at once derived by differentiation, and, as far as they are concerned, the method is not new, having been employed *with the aid of special tables* in various ways and under various modifications, and in Lyons' method the very formulæ are used.

"But I am not aware of anything analogous to the method of finding the correction c_3, on which the perfection of the process depends. This quantity c_3 will also be found to coincide with the result of a second differentiation, corresponding to the term of the second order in Taylor's Theorem.

"Allow me to notice an error in connexion with this subject in Baron Zach's paper in vol. v. of our *Memoirs*.

"The first example in the table of results I have given, is also the first worked in that paper, in which it is stated that the result exactly agrees with the trigonometrical process. This is not the case, they differ nearly seven seconds; and on applying the necessary corrections to the data, and re-working as the author recommends, the result agrees within a few tenths of a second with that which I have given."

Some astronomical and surveying instruments belonging to the late Capt. Copeland, R.N. and others, have been forwarded to the Society to be disposed of at very reasonable prices.

London:—Printed by G. Barclay, Castle St. Leicester Sq.

ROYAL ASTRONOMICAL SOCIETY.

Vol. XI. *February* 15, 1851. No. 4.

The Annual General Meeting of the Society, G. B. Airy, Esq., Astronomer Royal, President, in the chair.

The Rev. F. W. Russell, South Shields;
John Peto, Esq., Southampton;
E. J. Collingwood, Esq., Lilburn Tower, near Belford;
Charles Greville Prideaux, Esq., Lincoln's Inn; and
Rev. James Hill, Greenwich;
were balloted for and duly elected Fellows of the Society.

Report of the Council to the Thirty-first Annual General Meeting.

The pleasure with which the Council meet their constituents is often expressed in terms of unmixed congratulation on the prospects of Astronomy, as inferred from its history during the year elapsed. On the present occasion, it must be confessed that the recent loss of Professor Schumacher is a deduction of serious magnitude from the working power of our science. Trusting to what is yet left of that most useful astronomer, his memory and his example, the Council hope that the loss may be repaired by the joint efforts of those whose local position will enable them to aim at filling his peculiar place.

The Report of the Auditors, subjoined, will show the state of the finances:—

RECEIPTS.

	£	s.	d.
Balance of last year's account	480	14	5
1 year's dividend on £900 Consols	26	4	4
1 ditto on £2363 12s. 6d. 3¼ per Cents	74	11	8
On account of arrears of contributions	85	17	0
78 contributions (1850–51)	163	16	0
2 ditto (1851–52)	4	4	0
4 compositions	84	0	0
19 admission fees	39	18	0
16 first year's contributions	26	5	0
Sale of Memoirs, &c.	75	15	9
	£1061	6	2

EXPENDITURE.

		£	s.	d.
J. Rumfitt, bookbinder		7	3	10
J. Basire, engraver		7	4	10
G. Barclay, for printing Memoirs		127	3	1
Ditto ditto Monthly Notices, &c.		98	11	0
Cash paid for investment of £250, 3 per Cent Consols		241	17	6
Mr. J. W. Woollgar, for Library Catalogue		24	12	6
Taxes { Land tax and window duty, 1 year	8 3 1			
Taxes { Income and property tax, 1 year	1 9 2			
		9	12	3
J. Williams, 1 year's salary as Assistant-secretary		100	0	0
Ditto commission on collecting £395 15*s.* 9*d.*		19	15	9
Charges on books, and carriage of parcels		3	13	3
Postage of letters and Monthly Notices		26	19	7
Porter's and charwoman's work		13	18	6
Tea, sugar, biscuits, &c. for evening meetings		13	13	0
Coals, candles, &c.		12	18	6
Sundry disbursements by the Treasurer		23	14	8
Balance in the hands of the Treasurer (Jan. 1851)		330	7	11
		£1061	6	2

Assets and present property of the Society :—

				£	s.	d.
Balance in the hands of the Treasurer				330	7	11
1 contribution	of 6 years' standing		£12 12 0			
1 ———	of 5	ditto	10 10 0			
7 ———	of 3	ditto	44 2 0			
11 ———	of 2	ditto	46 4 0			
25 ———	of 1	ditto	52 10 0			
				165	18	0
Due for publications of the Society				2	12	0

£1150 3 per Cent Consols.
£2363 12*s.* 6*d.* New $3\frac{1}{4}$ per Cent Annuities.
Unsold publications of the Society.
Various astronomical instruments, books, prints, &c.

Stock of volumes of the *Memoirs* :—

Vol.	Total.	Vol.	Total.	Vol.	Total.
I. Part 1	45	V.	186	XIII.	277
I. Part 2	90	VI.	204	XIV.	464
II. Part 1	107	VII.	229	XV.	251
II. Part 2	73	VIII.	216	XVI.	277
III. Part 1	135	IX.	222	XVII.	271
III. Part 2	155	X.	236	XVIII.	297
IV. Part 1	158	XI.	247		
IV. Part 2	172	XII.	259		

Progress and present state of the Society :—

	Compounders.	Annual Contributors.	Non-residents.	Patroness, and Honorary.	Total Fellows.	Associates.	Grand Total.
February 1850	122	157	70	6	355	57	412
Since elected	3	15	...	...	18	5	23
Deceased..............	−3	−3	−4	...	−10	−2	−12
Removals	3	−3	...	...	...	...	...
Resigned..............	...	−2	...	...	− 2	...	− 2
Expelled	...	−3	...	...	− 3	...	− 3
February 1851	125	161	66	6	358	60	418

The instruments belonging to the Society are now distributed as follows:—

The *Harrison* clock,
The *Owen* portable circle,
The *Owen* portable quadruple sextant,
The *Beaufoy* circle,
The *Beaufoy* transit,
The *Herschelian* 7-foot reflector,
The *Greig* universal instrument,
The *Smeaton* equatoreal,
The *Cavendish* apparatus,
The Universal quadrant by Abraham Sharp,
The 7-foot Gregorian reflecting telescope (late Mr. Shearman's),
The Variation transit (late Mr. Shearman's),

are in the apartments of the Society.

The Brass quadrant, said to have been *Lacaille's*,

is in the apartments of the Royal Society.

The Standard scale

is in the charge of the Astronomer Royal, with the consent of the Council, to be employed in the formation of a new Standard Measure, under the direction of the Standard Committee.

The remaining instruments are lent, during the pleasure of the Council, to the several parties undermentioned, viz.:

The *Fuller* theodolite, to the Lords of the Admiralty.
The *Beaufoy* clock, } to the Royal Society.
The two invariable pendulums, } to the Royal Society.
The *Wollaston* telescope, to Professor Schumacher.
The other *Beaufoy* clock, to Mr. J. Drew.
The *Lee* circle, to Captain Blackwood.

The 4to. half-volume, containing the longer or more abstruse papers communicated to the Society, is now nearly printed. The articles are not numerous. The longest is one containing the observations made by the late Mr. Fearon Fallows at the Cape of Good Hope, *after* the erection of the Observatory and of the standard instruments. These observations have been fully reduced and printed under the personal care of the Astronomer Royal, at the expense of the Lords of the Admiralty. Your Council have already called your attention to the untiring and patriotic zeal of Mr. Airy, and to the prudent generosity of the Government. The friends of Mr. Fallows (and he had many friends) will rejoice at this contribution to his reputation, and the astronomical world will thankfully receive such an addition to that stock of *certain* facts on which the science rests. The Astronomer Royal may feel a just pride in the services rendered by him to his more immediate predecessors, Bradley, Maskelyne, and Pond; and to these must be added Groombridge and Fallows. Is it too much to hope that the Cape observations of the late Professor Henderson may meet the same or a similar editor? The Annals of the Cape Observatory would then be wholly published and perfectly available.

Professor Challis has contributed a valuable paper on the mode of ascertaining the errors of the pivots of transit instruments. However delicate the workman's tests may be, and however perfect the workmanship applied to the construction of astronomical instruments, the time is gone by when an astronomer of reputation can trust to an unexamined instrument. The most important verification, perhaps, regards the pivots of the transit instrument; and it is this problem which the Professor has solved, simplified, and exemplified.

Mr. Dawes has followed up a former contribution, "On the measures of Double Stars taken at Ormskirk," by a second and final memoir. We have thus a complete account of the labours of this exquisite observer in this most exquisite branch of practical astronomy, while he resided at Ormskirk. Though the instrumental means then in his possession are now far surpassed by those belonging to many observers, and particularly by those which he at present enjoys, the Ormskirk observations are exceedingly valuable from their date and their author. Let us hope that Mr. Dawes may speedily present us with the still more refined results which he has arrived at, while residing at Camden Lodge and Wateringbury.

To Mr. Main we are indebted for a very valuable and laborious paper on the proper motion of the stars contained in the Greenwich 12-year Catalogue. By the help of this memoir, the places of that admirable catalogue may be carried backwards or forwards correctly for several years, while the remarkable stars, which from their proper motion require particular attention, are pointed out as objects to be determined, and so separated from fundamental points. It is, perhaps, to be regretted that separate copies of this memoir were not struck off to accompany the 12-year Catalogue; but, for

the most part, the possessors of the one publication will naturally possess the other.

The arbitrary and inaccurate modes which many observers have employed in calculating the longitude from transits of the moon and moon-culminating stars, have struck every one who has had occasion to examine the subject. The Astronomer Royal has undertaken the simple and accurate solution of those cases which are likely to occur; and it is to be hoped that future computers will follow his guidance. The method itself is capable of giving the longitude of distant places with more ease and certainty, perhaps, than any other; and it is to observations of the moon and neighbouring stars that we must mainly look for the gradual improvement of terrestrial geography, by establishing distant normal points.

Professor Chevallier has contributed a short paper on transferring the constants given in the *Nautical Almanac*, relative to the occultations of stars by the moon, to other meridians. By the use of a special table, easily computed for each observatory, the calculation is rendered short and simple, and sufficiently accurate for its purpose. If occultations have lost some of their interest since the improvement of chronometers and the discovery of the electric telegraph, they still supply *one* of the best methods of determining the longitudes of distant places, and, perhaps, the most accurate places of the moon. Of late years their observation has been too much neglected.

Of the *Monthly Notices*, little more need be said than has already appeared in former Reports, and even this may seem unnecessary, as the *Notices* themselves are forwarded to every Member of the Society who wishes to have them, free of expense. They appear to answer the object proposed, viz. to give earlier and wider circulation to the discoveries of the day, to aid the observer with the necessary means for following out and reducing his observations, and to give a full and sufficient account of all memoirs presented to the Society. There is still some want of unity of design; an ephemeris of one planet is at times missing, when duplicates of another may be had. As the Society has no funds to be applied to computation, we are thus dependent on the zeal and goodwill of our friends at home and abroad. There is a little scruple felt in "conveying" ephemerides already printed into our pages, though this is at times overlooked. The general rule is, to abstain from all such ephemerides as are published in works especially designed for them, as the *Nautical Almanac*, the *Jahr-Buch*, &c., and to use the *Comptes Rendus*, and even at times the *Astronomische Nachrichten*, with more freedom. It would be, however, a violation of propriety to borrow largely from the *Nachrichten*, as that work *ought* to be in the possession of every astronomer. There is no way in which a competent computer can make himself more useful than in furnishing early ephemerides of newly-discovered celestial bodies, which are not as yet suffi-

ciently well known to obtain a place in the standard almanacs of France, Prussia, or England. Our acknowledgments are due to M. Leverrier, to M. Yvon Villarceau, to Mr. George Rümker, to Mr. Richard Schumacher, to Mr. Graham, &c., for their assistance in this department.

Notwithstanding the great advances made here and abroad to facilitate scientific communication, there are still difficulties in the way of transmitting to the Continent the *Monthly Notices by post*, or at least we are ignorant of the proper mode of doing it. In France and in other parts of the Continent, such articles can be sent *sous bande* at a very moderate charge; but, so far as we understand the foreign regulations, it is only *the produce of the country* which is thus allowed to circulate. With the seaboard of most civilised countries we can communicate at a very light cost, and in some cases with the interior. But we have no knowledge how to send a *Monthly Notice* to Italy or Switzerland without its costing far more than it is worth; and even in the interior of France, and perhaps in Germany, there seems to be a special and not very moderate postage from the coast. Probably some one familiar with the subject may be able to inform us of the proper way of sending *cheaply* and *rapidly* to the principal towns in Continental Europe; or, if that be not yet practicable, could put us, and others in our situation, into the way of applying to the proper authorities. We feel sure that attention will be paid to any reasonable proposition by our own post-office, and there is no ground to anticipate any objection elsewhere.

In putting together the *Monthly Notices*, some unnecessary trouble is given by slight variations from the customary form. It is desirable that these alterations should be as rare as possible. The MSS. should only be written on one side, and in columns not wider than the printed page will hold. In ephemerides, the places should be *apparent*, as in the standard almanacs; if the computer has not time for the reduction, the circumstance should be clearly pointed out. In this country the practical observer may be an indifferent computer, and almost always dislikes computation: in a variety of methods error is liable to creep in. So, in the observations, the precise extent of reduction should be stated (it almost always is), and everything arranged as is meant for the press. It is admitted that most of the observations come in a most workmanlike form, and that the trouble is in itself really not great. Some advantage would arise if the contributors of matter, which may require immediate attention, would carefully date the paper inside, and write "For the *Monthly Notices*" on the direction. As the Editor is not resident in London, this notice would hasten the delivery in cases where time is important.

The Council intend to take into serious consideration the propriety of making increased efforts for, and devoting additional expenditure to, the circulation of the *Monthly Notices* among the astronomers of the continents of Europe and America. The very great value of this rapid mode of communication will, they think,

justify an outlay of the sort, and the augmented means of the Society will permit it. The *Monthly Notices* are ardently wished for by many astronomers who find great difficulty in obtaining them. The proportion which the cost of distribution bears to that of print and paper is at present not one in five; and it is clear that if there must be a point at which, were it necessary, it would be worth while to print even less, that the result might circulate more, it follows that a Society whose means will afford it, exercises a wrong economy if it do not take care to obtain the maximum of very useful distribution before it begins to consider the future. And in adverting to this subject, the Council will remind the Fellows that the request formerly made for information as to ready means of reaching particular places will be better worth their attention than ever, if the Council shall find it desirable to make increased efforts of the kind described.

The Council have the pleasure of announcing that the catalogue of the library is now completed and published. The warmest thanks of the Society are due to Mr. Woolgar, under whose sole superintendence it was arranged and printed. These thanks are richly due, both for the admirable manner in which the details are presented, and for the economy with which they have been printed. The Fellows will now, for the first time, be able fully to judge of the value of the accession made to the library in the books of the Mathematical Society.

The Council have awarded the gold medal to Signor A. de Gasparis for his discovery of three new asteroids. The President will, at the close of the meeting, present the grounds of this award.

The Society has to regret the loss, by death, of our Associates MM. Schumacher and Trechsel, and of the following Fellows of the Society: — J. Caldecott, Esq.; J. Curnin, Esq.; Rev. T. W. Hornbuckle; Commander Wolfe; Sir Lancelot Shadwell; Capt. Stanley; Wm. Galbraith, Esq.; J. Lane, Esq.; James Pettit; Dr. Lane.

Heinrich Christian Schumacher, Conferenzrath, Professor, Knight Grand Cross of the Order of Dannebrog and Dannebrog's man; Knight of the Royal Prussian Order of the Red Eagle, 2d Class; of the Imperial Russian Order of St. Anne, with brilliants, 2d Class; of the Order of Stanislaus, 2d Class; of the Royal Swedish Order of the North Star; of the Legion of Honour, and Officer of the Order of Leopold in Belgium.

Fellow of the Royal Societies of Copenhagen, London, Edinburgh, Stockholm, Göttingen, Upsala, and Munich; of the Royal Astronomical Society of London; of the American Philosophical Societies of Philadelphia and Boston; of the Physiographical Society of Lund; of the Physical Society of Dantzic; of the Astronomical Society of Leipsic; of the Physical Society of Königsberg, and of the Imperial Society of Moskow.

Honorary Member of the Royal Irish Academy; of the Society

of Useful Arts of Edinburgh; of the Mathematical Society of Hamburg, and of the Physical Society of Rostock.

Correspondent of the Academy of Sciences of Paris; of the Imperial Academy of Sciences of St. Petersburg; of the Royal Academies of Sciences of Berlin; Brussels; Naples; Padua; Palermo; and Turin.

He was born at Bramstedt in Holstein, Sept. 3, 1780. His family, among whom is numbered the celebrated Count Griffenfeldt,* migrated to Holstein from Westphalia in the 16th century. His father, Andreas Schumacher, was first employed in the embassy at St. Petersburg, became afterwards private secretary to Christian VII., and was subsequently appointed *Amtmann*† of Bramstedt, and finally of Segeberg. Andreas Schumacher married Sophia Hedewig, born Weddy, daughter of a clergyman in Oldenburg, and widow of Hofrath Büsching, brother to the well-known geographer. Two children sprang from this marriage,—Heinrich, the eldest, and the subject of this memoir, and Andreas Anton Friederich, who was a distinguished officer in the Danish service, and died when adjutant to Friederich VI.

In 1790, Andreas Schumacher died, recommending his widow and young children to the care of the crown prince, afterwards Friederich VI., by whom he was greatly esteemed. The reigning sovereign bestowed a pension on his widow, who shortly after removed to Altona for the education of her children.

Before coming to Altona, the young Schumachers were instructed by Pastor Dörfer, himself well known as the topographer of Holstein and Schleswig. At Altona they attended the Gymnasium, which was worthily presided over by Jacob Struve, father of our celebrated associate, F. G. W. Struve. Under the care of this excellent teacher, Schumacher became a sound classical scholar; and as the mathematical master was not competent, he also studied mathematics under Jacob Struve's direction, who, himself a polyhistor in the best sense, privately instructed the most promising pupils in this department.

Very early Heinrich Schumacher had shown a taste for mathematics and mechanics: he was fond of making wooden clocks and instruments. But his frame was delicate, and it was at one time deemed advisable to remove him from all causes of excitement. He was accordingly placed in the house of a country clergyman; but having heard that his mother had bought for him a copy of Wolf's *Mathematics*, his impatience to return home and to resume his favourite pursuits was so strong, that his mother thought it best to allow him to return to Altona.

* Griffenfeldt was still considered to be the model of a Danish statesman a hundred years after his disgrace and death. "If I could get back Griffenfeldt alive," said Frederic VI. to the subject of this memoir, "I would dig him up with my nails."

† *Amtmann* is the principal magistrate of his district; its civil and political head. The districts in Holstein may contain about 15,000 or 20,000 souls. We seem to have no analogous single office.

After completing his studies at the Gymnasium, which he left with the reputation of its best scholar, Schumacher went to Kiel, in 1799, purposing to follow the law as a profession. He resided at Göttingen in 1801, and returned to Kiel for the next three years. Though he had little opportunity at Kiel to improve his knowledge of mathematics, he applied himself with great diligence to law, classics, and probably to modern languages. He used to say with some complacency, that if Horace, his favourite author, were lost, he could *restore* him; and the language of his Latin dissertations is said to be remarkable for its clearness and correctness. At whatever time he might acquire his modern languages, it is certain he possessed them with great mastery: he spoke and wrote Danish, French, and English,* with rare perfection, was well versed in Italian, and had made some progress in Russian.

In 1802, the Russian Emperor Alexander founded the University of Dorpat, and in 1804 the Gymnasium of that town was opened. Dr. Charles Struve, eldest son of Jacob Struve, was named the professor of Greek, and he recommended his schoolfellow Schumacher to supply his situation as tutor in the noble Livonian family of Von Meiners. Schumacher began to live with the family in the autumn of 1804, and as they resided alternately at Dorpat and their country-seat at Fölk, about 50 miles from Dorpat, he joyfully seized the opportunity, which his partial residence at Dorpat afforded, to resume his mathematics. In 1805 he began his translation of Carnot's *Géométrie de Position* into German, *ad recreationem animi*, as he says himself, in the introduction to the work. This translation, with notes by Gauss, was published at Hamburg in two volumes.

J. W. Pfaff was professor of astronomy and mathematics at Dorpat, and under his enthusiastic guidance Schumacher commenced his career as an astronomical observer and calculator. In a publication by Pfaff, which only extended to three numbers, the *Dorpater Astronomische Beyträge*, Schumacher contributed the places of the sun from Zach's Tables to Number II. In Number III. he explained an obscure passage in Hyginus, and also determined the latitude of Dorpat from sextant observations made between March 27 and April 8, 1807.

In 1806 he took his degree as *Doctor utriusque Juris* at Göttingen, in honour it would seem of his treatise, *Dispunctionum juridicarum specimen*, published at Dorpat in 1805. He chose for his doctor's thesis, "*De publicis servis populi Romani.*" This dissertation was published, and dedicated to his old friend and tutor, Pastor Dörfer.

But at Dorpat the young jurist's heart had been won for astronomy. His first intention was to go to Paris and place himself under Lalande. The death of Lalande, which happened in April 1807, deranged this plan, to which Lalande had given his consent.

* The Professor's skill in English may be judged of from this,—he could enjoy the writings of Dickens when read aloud to him.

In 1807 Schumacher returned to Altona. Through the patronage of Count Reventlow, *curator** of the University of Kiel, he obtained, in 1809, from the Danish Government a small allowance to enable him to perfect his scientific studies at Göttingen, under the direction of the illustrious Gauss. Here he made the personal acquaintance of that excellent astronomer, Olbers, and the friendships thus commenced continued till death.

In 1810, Schumacher was appointed extraordinary Professor of Astronomy at Copenhagen. He applied for permission to postpone his residence for a year, that he might complete an astronomical work which he had commenced in the private observatory of Repsold, his very intimate friend. This was granted, but the work has not yet appeared.

As Bugge was still professor of astronomy, and occupied the observatory of Copenhagen, Schumacher was advised by his sincere friend and patron, the late Duke of Augustenburg, to take charge of the observatory of Mannheim, then vacant by the death of the Abbé Barry. The permission of the King of Denmark to accept this office was granted, on the express condition that he should return to Copenhagen on Bugge's death. Previous to his entering upon his duties at Mannheim, Schumacher married Christine Magdalene von Schoon. He resided at the observatory of Mannheim till Bugge's death in 1815, when he was recalled to Copenhagen. Except his Latin tract on the latitude of Mannheim, it does not appear that there is any published account of his observations.

Before returning to Copenhagen, Professor Schumacher waited on Friederich VI. at Vienna. Notwithstanding the painful position of the Danish monarch at that eventful time, he made himself acquainted with the nature of Schumacher's duties, and ever afterwards showed himself a steady and liberal patron of astronomy and of its professor.

In the autumn of 1815, Professor Schumacher delivered a course of lectures on astronomy, *in Latin*, before the University of Copenhagen, and occupied the Observatory. In 1816 he prepared to carry into execution the trigonometrical survey of the kingdom of Denmark, which was also to include an arc of the meridian from Lauenburg to Skagen, the northern point of Jutland. As the survey commenced with Holstein, it was convenient that the director should live near the scene of his operations.

In or before 1820, Schumacher took up his residence at Altona, in a house bought for him by the king. Friederich VI. and Christian VIII. were both attached to science, and both most liberal patrons of astronomy and geodesy. The observatory of Altona was founded in 1823, and the first observation with the meridian circle of Reichenbach was made September 18, 1823. This observatory has become the point of union between Greenwich and the observatories of Germany and Russia, and has obtained a spe-

* *Curator* is the name of an officer which does not exist in our universities. He seems to be the patron and official protector, like our Chancellors, but with more action on the university corporation and studies.

cial reputation for the discovery of comets by Dr. Petersen. During the reigns of the above-mentioned monarchs, a museum was formed of the best astronomical and geodesical instruments from all countries. It is to this collection that England is indebted for the authentic copy of the *Imperial pound,* which has been adopted by Professor Miller in restoring the parliamentary standards destroyed by the fire of 1834.

In 1816 the Professor received at Munich, from Reichenbach, a theodolite, the first instrument required for the survey. In 1819 he visited France and England in reference to the survey. In the same year he determined the latitude of Lauenburg, the southern point of the proposed arc, with Ramsden's zenith sector, which the English Government had lent for the operation. On this occasion he was visited by his old friend Olbers, and by Bessel, probably for the first time. The intimate friendship between Bessel and Schumacher dates from this period, and continued through life. Whenever Bessel made a journey into Germany, he contrived to pay a visit to Altona.

Professor Schumacher, in his astronomical and geodesical pursuits, had the advantage of being most intimately acquainted with the celebrated artist, Repsold of Hamburg. Repsold constructed the excellent base apparatus, which Schumacher has described in his letter to Olbers, published in 1821. The measure of the base at Braak begun in 1820. Besides Repsold and his own assistants, of whom Professor Hansen was one, Schumacher was aided by Gauss, Bessel, Struve, and other astronomers.

Every year Professor Schumacher visited Copenhagen, to arrange the affairs of the survey and the observatory, and to present himself to the king. We are told that his reception by Friederich VI. and Christian VIII. was always of the most flattering nature. The Professor, by the desire of the latter monarch, wrote regularly to him, on the current events of astronomy and general science. During Olbers' life he made a yearly visit to Bremen.

In 1826 Professor Schumacher visited Munich a second time, to inspect the establishment of Utzschneider and Fraunhofer, and that of Reichenbach and Ertel, probably with reference to instruments for the survey.

In 1840 the Professor visited the magnificent observatory of Pulkova, which had been recently erected under the direction of Struve: and in 1842 he went to Vienna, to observe the total solar eclipse. This seems to have been his last scientific journey of importance.

Professor Schumacher's family consisted of three daughters and two surviving sons, of whom the youngest, Richard, has attached himself to astronomy. He is already favourably known as an observer and calculator to the readers of the *Astronomische Nachrichten,* and this Society has been obliged to him in the course of the past year for the elements and a careful ephemeris of Petersen's third comet, with an elaborate comparison of his ephemeris and the observations of different observers. Richard Schumacher is now

residing at Königsberg, to complete his studies under the able direction of Dr. Peters.

Among the Professor's numerous publications, it is sufficient here to take particular notice of the following.

A collection of Astronomical Tables, in two parts; the first part contains many of the tables most commonly required in the observatory; and the second part consists of the subsidiary tables by which the reduction of Lalande's *Histoire Céleste* has been performed. This part was dedicated to the Astronomical Society, towards which the Professor always felt great regard.

Ephemerides of the bright planets from 1820 to 1829, and of the distances of the bright planets from the moon for ten years, from 1822 to 1831 inclusive. The latter was published in English, and adapted to Greenwich mean time. In the remodelling of the *Nautical Almanac*, the introduction of the lunar distances of the planets was certainly the most important *nautical* improvement.

His astronomical *Jahrbuch*, from 1836 to 1844. This elegant publication, besides a variety of useful tables, contains numerous popular scientific views and summaries by the greatest geometers of the continent.

Lastly, Schumacher's greatest work, and that by which he will always be remembered as the most *useful* astronomer of his time, the *Astronomische Nachrichten*, which he commenced in 1821, and carried on till the time of his death. To this great work Schumacher brought extraordinary qualifications; unwearied industry, high scientific acquirements, the most favourable local position, rare knowledge of modern languages, and, what was still more important, a kind temper, united with enthusiastic zeal. His habits of business were exact, and his punctuality in correspondence unfailing. To this he added courteous and refined manners, principally, no doubt, owing to natural temper, but carefully cultivated by a large experience of mankind. He was thus enabled to unite astronomers of all countries and all shades of opinion in their common pursuit, and it is not too much to say that he principally has impressed upon astronomy its present cosmopolitan character.

In 1829 this Society awarded him their gold medal for the *Nachrichten*, and the President, Sir John Herschel, addressed him in the following words, which do by no means go beyond the limits of strict truth:—

" Among those numerous and talented individuals throughout the Continent, and in England, who are attached to astronomy professionally, or from love to the science, the *Astronomische Nachrichten* of Professor Schumacher establishes a point of concourse—a complete bond of union. We have there a theatre of discussion of whatever is most new and refined in the theory and practice of astronomy, the utmost delicacies of computation and scrupulous investigation of instrumental errors are given by those most competent to supply and to judge of them. To its pages observations of every kind find their way, especially those which depend for *their utility on* corresponding observations, or which lose their in-

terest and importance by long suppression. Not a comet appears but *there* we find its elements, handed in from all quarters with emulous rapidity. Occultations, moon-culminating observations, computations of longitudes and latitudes, disquisitions on practical points, descriptions, advertisements, and prices of instruments,—in a word, everything which can awaken and keep alive attention to the science, everything that can facilitate the contact of mind with mind. Every one who has attended to the progress of knowledge in recent times must feel all the importance of such an engine. But it cannot be kept in action without a strong presiding power. In any inferior hand it would languish and soon fall into disrepute and inaction. Professor Schumacher is, of all men, that one whom the voice of Europe would have fixed on for the conduct of such a work,—an excellent astronomer himself, and presiding over an observatory in which everything is delicate and exquisite, he possesses that practical and theoretical knowledge which commands respect and gives his acceptance or rejection of contributions a weight from which there is no appeal. He has, moreover, the eminent but merited good fortune to possess the full and effective support of a government deeply impressed with the importance of astronomical science. With this powerful aid, which would have been accorded to no other, he has been enabled to establish sure and regular communications with every part of the civilised world, and to face an expenditure which, under similar circumstances, no private individual would have ventured to undertake. He has thrown his whole weight into the scale of advancing science, and the effect has been the establishment of a great European astronomical republic, with a common feeling and a sense of common interests."

The *Astronomische Nachrichten*, in fact, contains the history of astronomical science for the last thirty years; it is the necessary complement and comment of almost every astronomical publication of value, and is the complete repertory of modern theory and practice, not of Europe, but of the civilised *world.*

Some very considerable works by Professor Schumacher have as yet not been published at all, or not completely so. The Danish arc of the meridian, the measure of the length of the simple pendulum from observations at Güldenstein in 1829–30, the determination of the standards of weight and measure, various chronometrical journeys for fixing longitudes, and numerous series of astronomical observations, are as yet in manuscript, but will probably be published before long.

Another most important service which Professor Schumacher rendered to astronomy was the assistance which he gave in training a large number of excellent men to calculation and the practice of observation. Gunlogsen, now professor in Iceland; Nissen, Deichgraf in Tondern; Hansen of Gotha; Clausen of Dorpat; Peters of Königsberg; and Petersen of Altona; were all chiefly formed in the school of Altona. Many others have resided at Altona, for longer or shorter periods, to profit by Schumacher's practice and

advice,—Olufsen, Ursin, Posselt, Selander, Von Fuss, Agaardh, Sievers, Neumann, Brorsen, Schmidt, Gould, &c. At his death, besides his son Richard, Dr. Olde, Sonntag, and Quirling, were qualifying themselves as astronomers under his direction.

Up to the commencement of the unfortunate disputes between Holstein and Denmark, Professor Schumacher's lot may have been considered as a very favourable one. The personal favourite and friend of his sovereign, surrounded by a cheerful family, highly esteemed by the most distinguished inhabitants of his own town and the adjoining city of Hamburg, directing the studies, practical and theoretical, of his young friends, and enjoying a widely extended correspondence with the most celebrated astronomers of Europe, his life was happily spent in the performance of his duties, and in enjoying very frequently, in his hospitable house, the personal visits of his numerous and attached friends. But latterly his position was greatly changed: the political troubles put a stop to the survey, and his feelings were greatly distressed by the quarrel of his native Holstein with the crown of Denmark, to which he had so many hereditary and personal obligations. The existence of the Altona Observatory was endangered, and even the continuation of the *Astronomische Nachrichten* put in doubt. In this critical emergency the astronomers throughout the world rallied for his protection. Almost every civilised country made, through its representatives, the most urgent requests to the Danish court that the observatory of Altona and its respected director should be spared and protected. Your Council addressed Lord Palmerston with great earnestness, and the cause of science could not have been entrusted to more able or energetic hands. His lordship strongly urged the deep interest with which this and other countries regarded the Professor, and obtained assurances from the Danish government that neither the Professor nor his establishment should be affected. Mr. Richard Parish of Hamburg, a very old and very dear friend of the Professor, supported him nobly through this crisis with his advice and sympathy, and with still more effectual means.

Though the Professor's constitution was naturally feeble, his regular life and careful attention to diet preserved him in a tolerable state of health; he was, indeed, not unfrequently indisposed, but his end was probably accelerated by distress of mind occasioned by these unhappy political quarrels. It would be hard to say what has been gained by either party, but the loss of many thousand valuable lives and of millions of wealth admits of no dispute.

Schumacher's natural refinement had, as we have already said, been cultivated by his association with the world; but he did not thereby lose his simplicity and kindness. At a first introduction, we are told that his manner sometimes appeared a little reserved, but this can only have been the case with perfect strangers;—at least the compiler of this notice, speaking from his own experience, would cite the Professor's manner as being exactly that which should belong to a man of the world, who was also a *man of science; frank* and open, and yet highly polished and cour-

teous. His friends (and they were very numerous) always found him a good-humoured, lively companion, full of anecdote, and an excellent listener. He was very fond of chess, but preferred looking on and discussing critical points to playing himself. He was intimately and deeply read on this subject, and maintained a large correspondence with the most celebrated players.

Nothing could surpass the kindness with which he attended to even unreasonable demands upon his time and attention. His industry enabled him to repair the loss, and his good-breeding subdued his impatience.

An incomparable husband and father, Schumacher's well-regulated mind was preserved in all its purity through life. He does not seem, so far as we learn, to have had any ill-wishers, though probably he may have been envied in his more prosperous time and good fortune. We fear that his generosity to others, and his delicacy about money-matters, which he carried to excess, may have indeed left his character the chief as well as the best inheritance to his family. In astronomical science his death has caused a void which cannot be supplied, and his bright example proves that scientific usefulness and even reputation may depend as much on goodness of heart as on those qualities which are purely intellectual.

The principal scientific Works of Professor Schumacher already published:—

Géométrie der Stellüng von Carnot, übersetzt, &c. Altona. Band I., 1807; Band II., 1810.

De Latitudine Speculæ Manhemiensis. Havniæ, 1817.

Astronomische Hülfstafeln, 1820–1829. Copenhagen.

Samlüng von Hülfstafeln. Copenhagen, Heft I., 1822; II., 1825. The second part was also published under the title of *Tafeln zür Reduction der Histoire Céleste.*

Ephemerides of the Distances of Venus, Mars, Jupiter, and Saturn, from the Moon's Centre. 1822–1831. Copenhagen.

Schreiben an Dr. W. Olbers in Bremen, &c. Altona, 1821. Containing a description of the apparatus employed in measuring the base at Braack.

Astronomische Abhandlungen. 3, Bde, Altona, 1822–5.

De Latitudine Speculæ Havniensis. Altona, 1827.

Astronomische Nachrichten, 1823–1850.

There are also several papers in Zach's *Monathliche Correspondenz,* Lindenau's *Journal,* Gergonne's *Annales de Mathématiques,* &c.

Jahrbücher, 1837–1844; containing essays, disquisitions, and memoirs by the most distinguished astronomers of Europe.

By Bessel's direction, Professor Schumacher edited *Populäre Vorlesungen über wissenschaftlische Gegenstände von F. W. Bessel,* Hamburg, 1848, after the author's death.

John Frederic Trechsel was born March 4, 1776, at Berthoud, in *Berne, of* an ancient but not rich family. He distin-

guished himself both by talent and energy at the school of his native town, from whence he proceeded, at the age of thirteen, to Berne, as a student in theology. As a resource, he was obliged to become a private teacher, in which capacity he made acquaintance with others of the same occupation, and in particular with two, who have since been known as the distinguished philosophers Herbart and Hegel. A fondness for metaphysical inquiry, and a predilection for the study of Kant, just then beginning to be generally known and appreciated, procured him the notice of Professor Ith, who recommended him to make a serious study of mathematics, as the indispensable foundation of all solid science. This he did under the celebrated Tralles, but without losing sight of his intended profession.

The revolutionary troubles of 1798 made a soldier of him, and he served as a volunteer against the French. After the capitulation of Berne and the proclamation of the Helvetic republic, he was examined and ordained. He was then still engrossed with public events, and would probably have either taken to political writing or have entered as chaplain into the Swiss legion in British pay, had not the battle of Zurich and its consequences damped his hopes. He abandoned his projects, and returned to the profession of teaching. After some time, he and two of his friends formed an institute for scientific education at Berne, which succeeded eminently, and obtained great reputation.

At the restoration of federalism, the new Bernese government founded an academy for the higher education in science. In 1805, at the first institution, Trechsel was called to the chair of mathematics, and seven years afterwards to that of physics. While thus engaged, he received various marks of esteem and confidence from the government. He was employed, in 1809, to examine and report upon the system of Pestalozzi, and afterwards upon that of Bell and Lancaster, as introduced at Fribourg by his friend Père Girard. He received the rights of citizenship, and was appointed chief librarian at Berne.

In 1812 he determined the latitude of Berne with precision, in conjunction with two French officers. This operation gave rise to the establishment of an observatory at Berne, the well-determined position of which made it a fundamental point in all the geodetical operations afterwards executed in Switzerland. In 1811, Trechsel had been appointed to superintend the triangulation of the Canton of Berne; and in this task, especially in its connexion with the French and Italian surveys, he passed several years. In 1816 and 1817 he was employed in establishing the level of the waters of the Jura, during which his health suffered by exposure in a marshy country. In 1819, the government of Valais employed him in the investigation of the causes of the inundation of the Val-de-Bagne, and the means of security for the future. From 1820 to 1830 he was mostly employed upon the weights and measures of Switzerland, and the introduction of the metrical system.

The change which took place in Switzerland after the French

revolution of 1830 produced its effect upon Trechsel's position, as upon that of other friends of the old order of things. It was with some difficulty that he procured permission to retain his chair when the academy was changed into a university. The anxiety which this altered state of things gave him, though comforted by the regardful attention of his colleagues, and, in the end, of the government itself, accelerated the failure of his constitution. He retired in 1847, and his resignation was received in a manner satisfactory to his feelings. A short interval of amendment soon followed, during which he employed himself in his post of public librarian. A cold, caught while returning from the country on a damp autumn evening, was followed by fever, of which he died, November 26, 1849. He was of full stature, of handsome and gentle countenance, and of a generous, benevolent, and energetic character—unwearied in his public labours, distinguished as a teacher both by will and power to explain, and by skill in experiment and demonstration. In every point of view his memory is highly regarded by his countrymen.

Trechsel published the following works:—

1. *Ueber wissenschaftliche Erziehung*, in Bezug auf die wissenschaftliche Lehr-anstalt. Eine Eröffnungsrede. Bern, 1801.

2. *Ueber Verstandesbildung durch Geometrie.* Bern, 1802.

3. *Ueber die Abhængigkeit der Geistescultur von der sittlichen Bildung.* Bern, 1803.

4. *Ueber die Gründlichkeit im Studiren.* (Literar. Archiv. der Akadèmie zu Bern. Band 2.) 1808.

5. *Ueber das Ehrgefühl und die Bildung desselben.* (Ibid. Band 3.) Bern, 1809.

6. *Bericht über die Pestalozzische Erziehungsanstalt zu Yverdon.* Bern, 1810.

7. *Nachricht von der im J.* 1811, *angefangenen Trigonometrischen Aufnahme des Cant. Bern.* (Literar. Archiv. der Akad. zu Bern. Band 5.)

Notice sur la Triangulation exécutée dans le Cant. de Berne. Extraite de la Correspondance de M. le Prof. Trechsel, Directeur en Chef de ce travail, avec le Prof. Pictet; accompagnée du tracé des principaux triangles et d'un tableau de la position géographique et des hauteurs des stations principales. (Bibl. Univers. de Genève, Sc. et Arts, vol. x.)

8. *Sur la Comparaison de deux Théodolites*, etc. Extrait d'une Lettre de M. Trechsel, Prof. de Mathém. à Berne au Prof. Pictet. (Bibl. Britannique, vol. lix.)

9. *Notice sur un grand Nivellement exécuté dans une partie du bassin de la Suisse occidentale*, sous la direction de M. Trechsel, Prof. etc.; et sur les donnés préparatoires à un projet d'abaissement du niveau des lacs de Morat, de Neuchatel, et de Bienne, au moyen d'une rectification de l'Aar et de quelques rivières adjacentes. (Bibl. Univ. Sc. et Arts, Nouv. Série, vol. viii.)

10. *Notice sur les Travaux préparatoires à un projet de redressement du cours de l'Aar*, et en particulier sur la mesure de la

vitesse de cette rivière dans un grand nombre des ses sections. Extr. de la corresp. du Prof. Trechsel, avec le Prof. Pictet. Avec fig. Ibid.

11. *Beschreibung und Vergleichung bernischer Maasse und Gewichte.* Bern, 1821.

12. *Bemerkungen über Blitzableiter und über Blitzsohlæge* veranlasst durch einige Ereignisse im Sommer 1819, von F. Trechsel, Prof. (Naturwiss. Anzeiger der allg. Schweiz. Gesellschafter f. d. Naturwissensoh. 1819, No. 2. Gilbert. Annalen der Physic. Band 64. Bibl. Univ. Sc. et Arts, Nouv. Sér., vol. xi. xii. et 15.)

13. *Bemerkungen über Lapostolle's Blitz, und Hagelableiter aus Strohseilen.* (Naturwiss. Anzeiger, 1821, No. 1. Literar. Archiv. der Akad. zu Bern. Band 4.)

14. *Nachricht von der in den Jahren* 1821 *und* 1822, *in Bern errichteten Sternwarte.* (Bibl. Univ. Sept. 1822. Literar. Archiv. Band 5.)

15. *Ueber die Verbindung der Naturwissenschaft mit der Mathematik.* Bern, 1832.

16. *Mittel und Hauptresultate aus den Meteorologischen Beobachtungen in Bern von* 1826–1836. (Denkschriften der Schweiz. Gesellschaften für die Naturwissenschaften. Band 2.)

17. *Observations Astronomiques pour déterminer la Latitude de Berne*, faites en 1812 par le Col. Henry, le Command. Deloroz, et le Prof. Trechsel. (Ibid. 1850.)

18. *Sur les Ombres coloriées*, par F. Trechsel, fils. (D'après les données du défunt. Bibl. Univ. v. 31. Edinburgh New Philosophical Journal, by Jameson, vol. xvi.)

T. W. Hornbuckle was a native of Bedfordshire, and was educated at St. John's College, Cambridge, where he took the degree of B.A. in 1797, and was third in the list of wranglers. Having obtained a fellowship, he was appointed one of the assistant-tutors, and in due time tutor, which office he held during the long period of 17 years. In 1827 he retired from college, having succeeded to the rectory of Staplehurst, in Kent, where he passed the remainder of his life.

Mr. Hornbuckle was not raised to any post of high dignity in the Church, nor did he seek fame by any publications. But in the two stations which he occupied, as a college tutor and a parish priest, his name is associated with sentiments of respect in the minds of all who were acquainted with him. He had the honour of having Sir John Herschel among his pupils. By all of them he was highly esteemed, both for his ability and for his kind attention to them. In general society he was also very acceptable, being of a very hospitable and social disposition, and his conversation distinguished by good sense, and by a peculiar acuteness and readiness of wit.

He was twice married, and by the first marriage had two daughters, who survive him. His death took place in 1848. He *may be accounted* one of that class of able men who, placed either

by choice or by the force of circumstances in a limited sphere of action, have been content with the good opinion of those among whom they lived, leaving to others, more ambitious or more fortunate, the arduous task of endeavouring to transmit their names to a remote posterity.

Commander JAMES WOLFE entered the navy in June 1814, from the East India Company's maritime service, and was employed in the Morgiana, Captain Sandilands, on the coast of Africa, and in the Adventure, Captain W. H. Smyth, in the Mediterranean, till the year 1823, when he passed his examination for lieutenant. In 1825 he joined the Blossom, Captain F. W. Beechey, and consequently was a partaker in the vicissitudes of that officer's interesting voyage round the world, which occupied a period of three years and a half. After obtaining his commission in 1829, he was appointed to several surveying-ships in succession, in each of which he acquitted himself meritoriously. In February 1843 he was promoted to the rank of commander and shortly afterwards commissioned to the Tartarus steamer, a vessel employed in the survey of the coast of Ireland. His excellent conduct in this department is attested by the various plans and charts which resulted from his operations, and were published by the Hydrographical Office of the Admiralty; especially those of the river Shannon, from its entrance up to Limerick; Upper and Lower Lough Erne; Bantry Bay; Bear Haven; and the Cove of Cork. He died on the 29th of November, 1849, at the age of 42.

Sir LANCELOT SHADWELL, Vice-Chancellor of England, was born May 3, 1779. He was educated at Eton and St. John's College, Cambridge, where he highly distinguished himself. He was called to the bar in 1803, and after a successful career, and a short occupation of a seat in Parliament, was promoted to what was then the sole Vice-Chancellorship, in 1827. After a long and honourable discharge of the duties of this high office, in which his manners made him highly popular, he died on the 10th of April, 1850. Sir Lancelot Shadwell retained to the last his taste for science and literature, in both of which he distinguished himself in early life. In would be out of place to describe his legal life or to eulogise his judicial merits, but he was well known in the world as a scholar and a gentleman; and your Council regret that, so soon after his admission as a Fellow of this Society, they should be called upon to pay this tribute to his memory.

Captain OWEN STANLEY, eldest son of the late Bishop of Norwich, was born on the 13th of June, 1811. After being educated in the Royal Naval College at Portsmouth, he entered the navy early in 1826; and in January 1830 joined the Adventure, commanded by Captain Philip Parker King, who was then employed in surveying the Straits of Magellan. After receiving his commission as lieutenant, he was appointed to various ships on the

Mediterranean station; and while in the Mastiff, with his former shipmate Captain Graves, he assisted in surveying the Grecian Archipelago. In May 1836 he was selected to take charge of the astronomical and meteorological departments of the polar expedition under Captain Sir George Back, in the Terror bomb. On returning from this harassing attempt in the autumn of 1837, he was appointed to the Britomart of 10 guns, in which vessel he aided in forming a colony at Port Essington, made a track survey of the Arafura Sea, and surveyed various harbours in New Zealand.

Captain Stanley attained post rank in September 1844, and two years afterwards was appointed to command the Rattlesnake, a small frigate fitted for surveying, and destined to explore the reefs and banks between the east coast of Australia and New Guinea. To this great work he devoted himself most diligently, and made various discoveries of importance: but the arduous nature of the service, the oppressive heat of the climate, and some very severe family afflictions—especially the deaths of his brother and father in a brief interval of time—preyed on his mind, and acting upon a system already much debilitated, brought his valuable life to a sudden close. He expired on board his ship, in Sydney Harbour, on the 13th of last March, at the early age of 38 years; and his remains were interred in the cemetery of that town with impressive funeral honours.

Captain Stanley on this expedition, as indeed he had always done, devoted his whole time and energy to the fulfilment of the onerous duties intrusted to him by the Lords Commissioners of the Admiralty; he was fond of scientific pursuits generally, beyond the usual acquirements of an ordinary nautical surveyor,—a class of which he proved himself, by his works, so able and so distinguished an example.

William Galbraith was born at Greenlaw, in Berwickshire, on April 23d, 1786. His parents were respectable, but not opulent, and they gave their son a good elementary education in the parochial school of his native place. He afterwards attended a school at Polwarth, near Greenlaw.

In 1807 he was appointed master of the parish school of Eccles. He did not consider the period of his residence there as the happiest one of his life. In Scotland the minister of a parish has the official superintendence of the education of the children in the parish school, and is chairman of the committee annually appointed by the presbytery to examine and report upon its state. In these examinations Mr. Galbraith felt himself in collision with the clergyman, and the result was annoying to his feelings. However, by steady perseverance he surmounted all his difficulties, and became the most popular teacher in the district. Pupils came to his school, not only from the neighbouring parishes, but from the surrounding counties. Dr. Rutherford, a member of the Council of this Society, walked twelve miles a-day, for some time, to enjoy the benefit of *Mr. Galbraith's instructions.*

In 1816 he resigned his situation at Eccles, and immediately settled in Edinburgh as a teacher of mathematics and nautical astronomy. His professional engagements in Edinburgh did not at first occupy the whole of his time, and he entered himself as a student at the University. After passing through the regular course of study there, he took his degree of A.M. in April 1821. He also attended the divinity class, and about 1832 he was licensed as a preacher by the presbytery of Dunse.

He married in 1833; and his widow is now left with their only child, a daughter, to struggle with the world; their sole dependence being in the sale of Mr. Galbraith's extensive library and valuable collection of astronomical instruments.

His constitution was naturally good, and he scarcely knew what a headach was till the spring of last year, when his health began visibly to decline; and after slightly complaining for some months, he expired suddenly at his house on the South Bridge, about 12 o'clock at noon, on Sunday the 27th of October, at the age of sixty-four years and six months.

To mental powers of no ordinary kind Mr. Galbraith united the most unwearied application, which soon gave him a name among mathematicians, with many of whom he kept up a constant correspondence. Though mathematics, natural philosophy, and astronomy, were Mr. Galbraith's favourite pursuits, he was an elegant classical scholar: he read, with fluency and ease, French, German, and Italian, and was, besides, more than ordinarily conversant with the history and literature of modern Europe.

To Mr. Galbraith's science and industry Scotland owes the resumption of the trigonometrical survey, as during his holidays he made a series of most accurate observations of several points on the western coast; and having found that these points were from a mile to a mile and a half erroneously laid down in all our maps, he induced several public bodies to interest themselves in the matter, and in consequence of their representations and petitions the survey was resumed. At the last annual meeting of the Royal Scottish Society of Arts, the President spoke of Mr. Galbraith in the following terms:—

"I may mention that, in 1837, Mr. Galbraith received the Society's gold medal for his paper on 'The Erroneous Geographical Position of several Points in the Frith of Clyde;' which communication tended materially to expedite the order for resuming the trigonometrical survey of Scotland. In the same year he also received the thanks of the Society for a very interesting paper 'On an extraordinary Instance of Refraction.'"

As an accurate surveyor and an admirable teacher of mathematics and nautical astronomy, Mr. Galbraith has left no superior in Scotland; nor will it be an easy matter to supply the place which his death has made void, and which he occupied many years with so much honour and credit to himself, and advantage to his country. Among his more private friends he was highly esteemed for the simplicity and honesty of his character, and for the genuine warmth and kindliness of his disposition, and he will be long

remembered by them with the strongest feelings of regard and esteem.

The works of Mr. Galbraith are not numerous, but they maintain a high character among practical men. The publication by which he is best known is entitled *Mathematical and Astronomical Tables.* The first edition of this work appeared in 1827, and the second in 1834. These tables are preceded by a copious Introduction, in which is embodied much highly useful and practical information. Besides this and some other publications, Mr. Galbraith communicated upwards of thirty mathematical, geodetical, and astronomical papers to different scientific journals; many of them requiring much research and labour, and all of them evincing that their author was not only zealously devoted to the practical applications of science, but a distinguished and successful cultivator of every region and department of modern mathematics. A list of Mr. Galbraith's works and papers is here subjoined :—

1. Mathematical and Astronomical Tables. Edinburgh. 8vo. First edition, 1827. Second edition, 1834.
2. Barometric Tables, for measuring Weights by the Barometer. Edinburgh, 1833.
3. General Tables for Astronomical Purposes. Edinburgh, 1834.
4. Article "Observatory," *Edinburgh Encyclopædia.*
5. Trigonometrical Surveying, Levelling, and Railway Engineering. Edinburgh, 1842.
6. A new and much-enlarged Edition of Ainslie's *Land-Surveying*, embracing Railway, Military, Marine, and Geodetical Surveying. Edinburgh, 1849. 8vo.

In conjunction with William Rutherford, LL.D., F.R.A.S.

7. A new Edition of Bonnycastle's *Introduction to Algebra;* also, a Key to the same. Edinburgh, 1848 and 1849.

In the London Philosophical Magazine and Journal.

1. Remarks on the Experiments of the Pendulum, made by Captain Kater, M. Biot, &c., with some new General Formulæ for determining the true Figure of the Earth. September 1824.
2. Paper continuing the above subject. January 1825.
3. Remarks on the Velocity of Sound. July 1825.

This paper was translated into French, and published in the *Bibliothèque Universelle,* at Geneva.

4. On the Figure of the Earth. March 1826.

An abstract of this and some other connected papers has been translated and published in German, in a work on natural philosophy, by Gehler, at Leipzig.

5. Further Investigations on the Velocity of Sound. September 1826.
6. Same subject continued, with Remarks on the Experiments of Professor Moll of Utrecht. May 1827.
7. On the Determination of the Figure of the Earth; with

Remarks on the Solutions of Professor Airy of Cambridge. July 1827.

8. Determination of the Latitude and Longitude of the Observatory on the Calton Hill, by new Methods. April 1829.

9. On the Deviation of a Falling Body from the Vertical to the Earth's Surface; with Remarks on the Solutions of Emerson and La Place. November 1829.

10. On the Reduction of the North Polar Distances of Stars observed at Greenwich. May 1831.

In the Edinburgh New Philosophical Journal.

11. Barometric Measurement of the Height of Ben Lomond, &c. October 1828.

12. On the same subject. January 1831.

13. Same subject continued October 1831.

14. On the Magnetic Properties of the Rock on the Summit of Arthur's Seat. October 1831.

15. Barometric Measurement of the Height of Cheviot, by Sir Thomas Brisbane and Mr. Galbraith. No. 27.

16. Review of Sir Howard Douglas on Military Bridges. April 1832.

17. Review of Sir Howard Douglas on Naval Tactics. November 1832.

18. Remarks on Borda's Geometrical Measurement of the Height of the Peak of Teneriffe. January 1833.

19. Formula for Trigonometrical Surveying. October 1833.

20. On Worleman's Correction of Middle-Latitude Sailing. April 1834.

21. Notice of a New Pocket Box-Circle, for making Observations at Sea or on Land; for which, on the Report by Professor Forbes and Mr. Sang, the silver medal of the Society of Arts was awarded. December 1836.

22. Essay on the Erroneous Geographical Position of several Points in the Frith of Clyde; for which the gold medal of the Society of Arts was awarded. December 1837.

23. Remarks on the Geographical Position of some Points on the West Coast of Scotland. January 1838.

24. On the English Arc of the Meridian. April 1843.

25. On the Tides and Dew-Point, January 1850.

26. On the Tides. April 1850.

In the Presbyterian Review.

27. Review of Young's *Elements of Mechanics.* July 1832.

28. Review of the *Mechanism of the Heavens,* by Mrs. Somerville. September 1832.

29. Review of Plana's *Theory of the Moon.* July 1834.

30. Review of Carlini's *Solar Tables.* September 1834.

IV. *In the Journal of Agriculture, published under the Patronage of the Highland and Agricultural Society of Scotland.*

31. Essay on Wheel-Carriages.
32. Same subject continued.
33. Essay on a Geological Survey of Scotland.

Mr. James Pettit was the son of a farmer at Bedford, at whose death he came to London, and followed the profession of music with great success; but having obtained introduction to some of the first families in the kingdom, he succeeded in an application to become a clerk in the Bank of England; in his leisure hours he devoted his time to the study of optics. He made a number of achromatic telescopes, some of which are much above mediocrity. He also studied medicine, and was passionately fond of mesmerism; bodily afflictions, and the number of years he held the situation of a clerk in the Bank, induced the directors of that establishment to grant him a retiring pension; upon which, besides other property he possessed, he lived in great suffering until his decease, which took place the 25th day of November, 1850, in the 76th year of his age.

Though some inquiry has been made, we have not been able to get any personal account of Lieut.-Col. Wilcox, late Director of the Observatory of Lucknow; but from his correspondence with one of the members of the Council, we can state some particulars of his scientific labours.

The Observatory of Lucknow was founded by the King of Oude on a considerable scale, and furnished with instruments of the highest class: a mural circle of 6 feet; an 8-foot transit; and an equatoreal of more than 5 inches' aperture by Troughton and Simms, with clocks by Molyneux. It certainly was the best-equipped observatory in India.

Colonel Wilcox took the direction of this establishment—at least he commenced his observations—about the middle of 1841; and we have good reasons for believing that he was both zealous and able in the performance of his duty. An extract from a letter, dated 1846, Jan. 7, is as follows:—

" It is time that I should tell you how we have been employed. Mr. Airy, very kindly, in reply to a letter which I wrote him on the subject, pointed out that we ought to take advantage of our more southern latitude to make a great number of daylight observations of the planets; and he thought that the clearness of our atmosphere might enable us to see the small planets better than you do in Europe. Whether we have succeeded in either of these points I am not quite sure. We have certainly made a great number of observations of the planets by day; but then we have to contend with a disadvantage belonging to the high range of our temperature—I am not aware, at least, that you experience it equally—*the tremulous* motion of the atmosphere, which occurs to so ex-

cessive a degree during the day, that I have frequently seen *Venus* jump away from the wire the full extent of her semi-diameter; and with regard to the smaller planets, although we can get on very well with *Vesta* and *Ceres*, *Juno* we have always found impracticable, and with *Pallas* we succeeded the first year only. Mr. Airy thought that as so much had been done elsewhere in star astronomy, I need not give much attention to it. Before, however, I received his letter, an expression in one of yours, in which you tell me that, although Mr. Taylor's places are good, I ought with my fine instruments to give better, had already given a bias to my views; and this was increased when I experienced some disappointment in accomplishing, as I would have wished, the objects chalked out for us by Mr. Airy. The consequence is, that I have made a great many observations of stars; and instead of limiting myself to two or three upon each, as Mr. Taylor had done, I took ten for my limit; and although some stars have not been observed so frequently, that number has been exceeded, I believe, with the major part. It is easier to observe than to reduce; and fifty stars, which were easily observed at night, take up by day more time than we have to spare for them. In observing with the mural circle, it is my plan to work hard for a limited space of time each evening, and I have three people employed — two to read the microscopes and one to write. One could not wish for better observers than our educated Hindoo lads turn out; and I believe that our transit observations — in which I take no part myself — will compete with those of any observatory. With the equatoreal I have done nothing more than to use the telescope for eclipses of *Jupiter's* satellites. I have observed but few occultations, on account of their requiring time for the previous computations; but the pillar on which the equatoreal is placed, and which was built before I took charge, runs up to so great a height, that a touch of the finger will make it vibrate, and a level resting upon it is altered 7″ on removing or applying the weight which moves the clock." Then follow some queries as to the mode of observing the small planets without illuminating the field.

The main object of the foregoing letter was to ask for information as to the mode of publication, and the probable expense. There is no printing-press at Lucknow, and Calcutta, the nearest place possessing a press competent to such a task, is 600 miles distant. The king, moreover, though willing to pay down at once a sum of 500*l.* or 600*l.*, demurred to a large *annual* expense.

The conclusion to which Colonel Wilcox inclined, was, to compress the work somewhat by leaving out the less important steps of the reduction; and to ask the Astronomical Society to superintend the printing of the work, either as a portion of their *Memoirs*, or in a separate form, at the king's expense.

In a later letter (1847, January 22), Colonel Wilcox says, "His Majesty has placed 600*l.* in my hands for printing the first three years' observations, separately, after which he is willing to grant 50*l.* or 60*l.* annually to have our results printed in the Memoirs,

if the Society will accept them. I should have been better satisfied with a different decision, and to have made over my papers to the Society; in which case I should have been relieved from the further trouble and perplexity of printing. Truly I do not know how to proceed. A press of my own, working under my own eye, would have many advantages; the first of which would be the saving of an enormous quantity of writing in making a complete copy; but judging by our printing in India, when executed by moderately experienced hands, I should fear that it would turn out very wretched indeed where experience is wanting, and we have not a press in all Lucknow. Calcutta, at the distance of 600 miles, offers little advantages over England; while to perform that most important and troublesome task of correcting the press, I suppose we should with difficulty find a capable person. Will you kindly assist me in my dilemma with any suggestions which your experience may afford? Were I to make over the papers to the printers of the B. A. Catalogue, or those of the Greenwich Observations, could I rely on justice being done? or would it be absolutely necessary to employ an intermediate party, and would the expense of so doing be large? I ought not to omit to state that one reason for preferring England is, that I would wish to make over the whole impression to the Society for distribution. I fear that with 600*l.* I have but barely sufficient, if indeed enough."

Colonel Wilcox then enters into some estimates of the expense of printing his observations for three years, 1841, 2, 3, upon certain data supplied by Mr. Richardson of Cornhill, and a comparison with the Cambridge volume of 1835, and concludes that the sum would be scarcely sufficient if the observations were given in the same detail as in the Cambridge volume. His calculation, indeed, which is only approximate, seems to carry the work to nearly 1300 pages.

Some preparatory inquiries were made in order to get Colonel Wilcox the necessary information. It was intended to recommend to him the form of the later Oxford volumes, as being sufficiently extended, and yet compact and elegant; but a good deal of delay occurred, and nothing was done before the report of Major Wilcox's death reached England.

In the latter end of 1849 the following letter was received from Dr. Sprenger, Principal of Delhi College:

"Lucknow, 14th Sept. 1849.

"My dear Sir,—You are probably informed of the death of Lieut.-Col. R. Wilcox, Astronomer to the King of Oude: it happened in October 1848. Two months ago, the king abolished the observatory, and the papers and instruments are in charge of a native officer, who neither knows English nor astronomy. Some years previous to the death of the late Colonel W. the king granted six hundred pounds for printing the observations. This sum is in trust of Mr. Wilson, of Ghazeepore, the colonel's executor and brother-in-law, and might still be made available for that purpose.

The observations for three years (1842, 1843, and 1844) are reduced, and might at once be printed; and it is likely that a beginning would have been made ere this, were the (British) Government of this country convinced of the utility of the undertaking. I have spoken on this subject with the Secretary to Government, and with the Resident of Lucknow; and it is with the sanction of this latter that I write to you. As you have been in correspondence with Colonel Wilcox regarding the publication of his observations, you are probably acquainted with the details; and if you think that it would be useful to publish them, and that they could be printed—the whole or in part—with the assistance of the above sum, or if you think it would be useful to deposit them in MSS. in your Society or in the Observatory at Greenwich, your Society have only to express their views and wishes in a letter to Colonel Sleeman, Resident at Lucknow, insisting on the utility of the observations; and I have reason to believe that he will obtain from the king and send you the MSS. and the sum which has been set apart for printing them. If the papers remain here, they will be destroyed by the white ants in a few years or months. Perhaps it would be useful if you would give some suggestions what might be done with the instruments. You will excuse my troubling you as a stranger.

"I am, &c.

"A. Sprenger.

"P.S. The mural circle and transit instrument are facsimiles of those at Greenwich."

To this the following reply was sent by order of the Council:—

"Royal Astronomical Society, London, Jan. 8, 1850.

"Dear Sir,—Your letter of Sept. 14, 1849, was brought before the Council of the Royal Astronomical Society at their first meeting. I am afraid the delay is partly my fault.

"The Society could not undertake to copy the Lucknow observations at their own expense in any case (we have, in fact, no funds except those that are barely sufficient to carry on the Society and to print our *Memoirs*), but there is a strong wish to publish valuable observations if the cost is defrayed by other parties, which seems here to be the case. The Astronomer Royal and I were directed to write to you, and to say that nothing can be resolved upon until the MSS. have been sent to this country and carefully examined. If they should be of sufficient interest, a responsible editor will be found among the members, and the work published as completely as the funds will allow. There will necessarily be a great deal of computation, which is drudgery, to be paid for. This is not, however, very expensive where the work is perfectly cut out. The editorship will be, of course, gratuitous.

"I am, &c.

"R. Sheepshanks.

"A. Sprenger, M.D., Principal of Delhi College."

Since this we have received no information from Lucknow respecting the observations or the instruments. It would be a great pity if either were allowed to be lost or wasted.

The new Transit-circle of the Royal Observatory of Greenwich is now mounted and in full use; in fact, the old transit instrument (Troughton's) is dismounted; and, since the beginning of the year, every determination in the observatory rests upon the observations made with the new instrument. The erection of this instrument will form, we may expect, an epoch in the history of astronomical mechanics. The object originally proposed was, to construct a meridional instrument carrying an object-glass of unprecedented size: the collateral objects which, it is hoped, have been attained at the same time, are, the securing of firmness and of accuracy to a degree not before known. Although some of the leading ideas in the construction of this instrument have from time to time been communicated to the Society, yet a brief history embracing the whole may not be ill-timed on the present occasion.

When the want of meridional instruments carrying object-glasses of larger aperture than those existing in the observatory had been stated by the Astronomer Royal, and recognised by the Board of Visitors, the next subject of consideration was, what form ought to be chosen for a new instrument? The least consideration of the form of Troughton's mural circle showed that it would be utterly unsafe to load such a construction with a telescope of the dimensions and weight it was proposed to attach to the new instrument. It was soon determined that the form of the ordinary transit is better adapted than any other to carry a weighty object-glass; and it was then obvious that a single instrument of the class of transit-circle might efficiently replace the two instruments (transit and mural circle) then in use. And it is to be remarked that the combination of the two functions in one instrument, when not accompanied with any positive inaccuracy, is highly advantageous, both as relieving the staff of observers, and as removing all doubts of the correspondence of the two elements observed to one and the same object. In no instance have the advantages of this instrument been proved more completely than in the great work of the late Mr. Groombridge. Of transit-circles there are two kinds; one, which may be called the English, in which the limb of the circle is firmly attached to the telescope; and one, which may be called the German and French, in which both the telescope and the central parts of the circle are united to the central parts of the axis, leaving the ends of the telescope and the circumference of the circle free. The Astronomer Royal preferred the latter, believing that with this arrangement the anomalous strains would be less, the circle more likely to preserve truly its circular form, and the flexure of the telescope more likely to follow the law which applies to the simplest cases of bending. The graduated circle being placed on one half of the axis, a circle of similar dimensions, intended to receive the action of the clamps, might advantageously be placed on

the other half. The general form of the instrument, therefore, may be understood as a telescope nearly 12 feet long, 9 inches in diameter at each end, and 18 inches diameter in the middle; carried by an axis 6 feet in length, which consists mainly of two cones whose bases are 18 inches in diameter, with pivots 6 inches in diameter, united at their intersection by a cube of 20 inches, with a 6-foot circle embracing each cone and attached to the side of the cube.

The next point was, the choice of material. It was thought proper to secure, if possible, three conditions; one, that the essential parts of the instrument should be in as few pieces as possible; the second, that the pivots should be in the same piece with the axis to which they are attached; the third, that the pivots should be hard. All these conditions were obtained by the adoption of cast-iron, the pivots being hardened by the process termed *chilling;* the telescope with its axis and pivots are made in only four pieces. Each of the circles is cast in two pieces, one cast embracing the radii or spokes, and one cast applying to the ring only.

The pivots rest upon chilled iron V's, which are solidly bedded, without any adjustments, each near to the centre of its pier. The mass of stone in the two piers exceeds 50 tons.

As an instrument of this ponderous character (weighing about a ton) could not easily be reversed, the following method is adopted for determining its line of collimation. Two collimators (5-foot telescopes, with $3\frac{3}{4}$-inch object-glasses) are planted on solid piers, one to the north and the other to the south of the instrument; and a mechanical apparatus is adapted for raising the instrument (keeping its ordinary counterpoises in their usual action), so far that the collimators can view each other. In this state a nearly vertical wire in one collimator is adjusted, by a micrometer-screw, upon a nearly vertical wire in the other; then the instrument is lowered, and the collimator-wires, as seen in its telescope, are used as opposite marks at an infinite distance. This method is found to be susceptible of very great accuracy. As the application of a level would be impracticable, the image of the middle transit-wire, as seen by reflexion in mercury, is made to coincide with the wire as seen directly, and the comparison of this position of the wire with the position for collimation gives the inclination of the axis. For these operations it has been found convenient that the whole system of transit-wires should be carried by the micrometer-screw.

The arrangements for these important adjustments were considered to be adapted, not only to extreme accuracy of result, but also to great facility of arriving at it; and, in point of fact, the determination of the line of collimation, and of the inclination of the axis (when the air is tranquil), are easier with this large instrument than with smaller instruments. Yet, after the completion of the instrument, and when it was too late to make an alteration without completely remaking the instrument, it was pointed out by Mr. Simms that the most troublesome part of the operation (the raising

the instrument in order to allow of the verification of the position of one collimator with respect to the other), might have been completely avoided. It was only necessary to leave a hole of 4 inches diameter through the central cube of the instrument, and then, by placing the telescope in a vertical position, one collimator would at once view the other. It is to be wished that this suggestion may be adopted for any future instrument constructed on the same general plan.

To determine the error of form of the pivots, a good 6-foot object-glass, of 3 inches aperture, is permanently fixed in one pivot, and a ghost-apparatus in the other pivot at the focus of that glass, constituting, in fact, a collimator revolving with the axis of revolution of the transit. This collimator is viewed by a 7-foot telescope, solidly planted on external piers; and the measures of the apparent movements of the collimator-point in the horizontal and vertical directions, made by means of a micrometer in the 7-foot telescope, give the elements for determining the form of the pivots. They are found to be extremely good.

The use of the graduated circle in combination with the internal micrometer, for the determination of zenith distances, is precisely the same as in the old circle, according to the practice of several years' standing at the Royal Observatory. The zenith point is determined, either by observing the image of the wire by reflexion in mercury, or by observing stars by reflexion. The mercury trough contains more than 50lbs. of mercury. It was necessary to construct a large apparatus which should carry this trough constantly in a horizontal position, through a considerable distance in the north and south direction, and through a small distance in the east and west direction. It was also necessary to arrange for easy transportation of the mercury to and from its store. All these purposes have required special mechanical arrangements.

In alluding here to the graduated circle, a peculiarity of its construction may be mentioned which was designed in the first conception of the plan of the instrument. In order to avoid the very great labour of reading microscopes on different parts of the limb of a 6-foot circle (the eye-ends of the microscopes usually occupying a circle of more than 7 feet in diameter), it was planned that the microscopes should pass in a diverging conical arrangement through the stone pier that carries one pivot of the axis; and thus the eye-ends of the microscopes are contracted into a circle of less than 2 feet in diameter, while at the same time the utmost stability is secured for the microscopes. And in order to avoid the trouble of illuminating the ordinary pierced reflectors, and the difficulty of adjusting them, it was planned that a single light in the line of the axis, and not far from the centre of the circle formed by the microscope eye-ends, should give light (without the intermediation of any reflector) through other holes, bored through the stone pier, upon those parts of the circle to which the microscopes are directed. And as the axis of each pencil of light and the axis of *the corresponding* microscope are inclined to each other several

degrees, it was necessary for bright illumination that the normal to the metallic surface of the divided limb should bisect the angle formed by those two axes; and thus that the divisions of the limb should be cut upon an internal cone or dished surface. The whole of this arrangement is eminently successful; the illumination and the facility and accuracy of reading probably surpass anything of the same kind that has ever been seen before.

It was thought highly important that means of permanent character should be provided for the examination of the accuracy of the graduation. Five additional holes for microscopes, accompanied with five corresponding holes for illumination, were accordingly bored through the pier. By means of these, the divisions have been examined to every degree, and the result is most satisfactory. Means are also provided for the examination of every division of 5′, but they have not been used, as there does not appear to be any probable irregularity of small portions which demands this scrutiny. It is proper to mention that the circle was divided on Mr. Simms' dividing engine; and that Mr. Simms, in order to give the best possible chance of accuracy, had the division effected at night, when the ground might be supposed to be least disturbed.

The absolute flexure of the telescope was determined by fixing a mark in its object-end and a 3-feet object-glass in the central cube, and observing the image of the mark with eye-end north and eye-end south. It was thus found that each end drops about $\frac{1}{1000}$ of an inch, or about 3″, as viewed from the centre. It is, however, the difference only between the two drops which affects astronomical observations. For determining this, advantage has been taken of the two collimators. A nearly horizontal wire in one is adjusted upon a nearly horizontal wire in the other, and then the apparent angular distance of these wires is observed with the telescope of the instrument and the graduated circle. The astronomical flexure of the telescope appears to be only a small fraction of a second.

Among minor arrangements it is proper to state, that, by a very simple contrivance, the same light which is commonly employed to illuminate the field is made to illuminate the wires in a dark field, no other movement being required than merely continuing the motion of the rod by which the field-light is graduated. The advantage of this construction has already been felt.

Your Council have thought it desirable to enter into these details at some length, because they consider that they may have an importance greatly exceeding that of the mere construction of a new instrument of the National Observatory. The instrument in question is a specimen of the kind of changes which may be anticipated as necessary in the increase of dimensions likely to be given to the object-glasses of telescopes. It presents an instance also of the advantage of sometimes having recourse, for the perfection of an instrument of science, to a branch of art scarcely employed on it before; for it is to be observed, that the greater part of the work in the construction of this instrument is engineers' work, and that

it could not have been intrusted to any other class of artificers. Even their general skill would have been found insufficient unless aided by the great improvements in the construction of modern engineers' tools, and, above all, by the devotion of Mr. May's personal attention to the instrument. On the other hand, nothing but the nicest work of the dividing engine could have ensured the accuracy of gradations, of micrometer-work, and of optical work, which are found in this transit-circle. On one of these points the Astronomer Royal acknowledges his obligations to the talent and zeal of Mr. Simms; and so far as the graduations are concerned, it is probable that no other dividing engine exists which would have fulfilled the conditions required.

The preparations for using the American method of recording transits, to which the Astronomer Royal has once called the attention of this Society, are far advanced, but not sufficiently so to enable us to give any account of their actual use. The preparation, also, of an instrument on the plan suggested by the Astronomer Royal, denominated the Reflex Zenith Tube, is advancing, the object-glass of the former transit being used for it.

Before dismissing the instruments which have for thirty years sustained the reputation of the Royal Observatory, it is proper to remark that they had in some measure lost their credit in the estimation of the persons who were most closely concerned with them; and the steps by which the observers have been led to this, in regard at least to the transit, are curious and instructive. When the altitude and azimuth instrument (or altazimuth as it is now called) was mounted, it was intended that its zero-point in azimuth should be determined solely by observations of stars in azimuth, the corresponding time being found by comparison of the altazimuth-clock with the transit-clock. Great discordances were found among the resulting zero-points, and after clearing off several causes of error there remained but two possible explanations of the discrepancies which remained, namely, either that the horizontal circle was unstable, or that the observation of time at the transit-instrument was bad. A 25-foot object-glass (formerly used for the zenith-tube) being at the disposal of the Astronomer Royal, it was mounted as a collimator for the altazimuth; and thus there were means of comparing three different elements, namely, the meridian-direction as given by the transit-observations, on the assumption that the transit-instrument is good, the meridian-direction as given on the assumption that the horizontal circle is steady, and the meridian-direction as given on the assumption that the collimator is steady. The close agreement of the two latter results have given a presumption amounting to moral certainty that the fault is entirely in the transits; and upon examining the constants of the transit-adjustments in many cases of conspicuous discordances of zero-points of azimuth in the altazimuth, there has been found (the Astronomer Royal believes in every instance) something suspicious in the adjustment-determinations, especially in later months, in the *collimation of the* transit. The Astronomer Royal fully hopes that

these sources of error will be greatly diminished, or even entirely removed, in the use of the new transit-circle.

At Oxford, Mr. Johnson is busily engaged in the completion of the circumpolar catalogue.

Almost all Groombridge's stars, which can be identified, have now been reobserved. The few which are not to be found are generally those which Groombridge observed only *once*. The new catalogue will contain nearly 2000 additional stars. It is expected that the work will be completed in the course of the present year, and be ready for publication in 1853. Some progress has been made already in its reduction to the epoch 1845. The Society is aware that the personal force of the establishment is not more than sufficient to grapple with this work alone; consequently, no definite course of observation has been begun with the heliometer.

Mr. Johnson devoted the early part of the last year to the study of the instrument, and to its manipulation. He sees no reason to mistrust its powers. Probably it will be found more efficient in measures of larger distances—such, for instance, as exceed 4″ or 5″—than in smaller ones; but this will not detract from its value in that class of researches in which it will be principally employed.

An inconvenience is at present experienced in a little displacement of the half-object-glasses; in consequence of which a single image can never be obtained. This is an adjustment which probably it will always be difficult to effect rigorously, and, if effected, would be liable to change. At present the displacement is inconveniently large. No doubt, when the instrument comes to be regularly worked, this may be remedied.

An application has been made to the Radcliffe Trustees to increase the personal establishment, more nearly to meet the present wants of the observatory. Their answer is expected very shortly. The application was to have been made last summer. It was delayed by a circumstance for which the trustees are not responsible. The melancholy death of Sir Robert Peel was a cause of further delay.

In mentioning the name of this distinguished statesman in connexion with the Radcliffe Observatory, we cannot pass unnoticed the interest he took in its affairs—an interest far more active and beneficial than arose from mere official connexion with it as one of its trustees.

He was the first to suggest the acquisition of the heliometer. The erection of the meridian-circle—of the new transit-instrument—the purchase of the excellent library of the late Mr. Rigaud—the annual publication of the observations,—are all events which mark the period of his trusteeship. Nor was it to its more important concerns that he confined his attention: no suggestion which tended to increase the efficiency or public utility of this observatory ever failed to receive the benefit of his advice, encouragement, and support.

It was the intention of himself and of his colleagues to have visited

the observatory, in company with a number of eminent scientific men, for the purpose of inspecting the heliometer; and on the morning of the day on which he met the fatal accident he spent some time in giving the necessary directions for this visitation, appointing a day, and naming the persons whom he wished to be invited.

The operations of the Cambridge Observatory have settled down into a course which Mr. Challis hopes will be continued for a long time, experience having shown that the most effective work in astronomy is done by adhering steadily to a fixed plan. The sun is constantly observed; the moon and culminators with the moon are observed for the purpose of contributing something towards the determination of terrestrial longitudes; a large list of zodiacal stars, situated within 5° N. and S. of the ecliptic, to the 9th magnitude inclusive, have been catalogued for observation, to serve as reference-points for equatoreal observations of the recently-discovered planets: many of the moon-culminating stars are included in this list. The observations of these zodiacal stars are proceeding at a steady, but not rapid rate. The recently-discovered planets are observed as often as possible on the meridian, and when nearer quadratures they are followed with the Northumberland equatoreal. The pursuit of these bodies in extreme positions is often troublesome, on account of its being necessary, for want of sufficiently extended ephemerides, to compute additional places from the elements. The older planets, being well taken care of at Greenwich, are not observed. Comets, especially those of short period, are attended to. Occultations of fixed stars and planets by the moon, solar eclipses, and transits over the sun's disk, are observed at every available opportunity.

Faye's Comet was observed on Nov. 28 of last year, on its first return since its discovery in 1843.

The sixteenth volume of *Cambridge Observations*, containing the meridian observations of 1844 and 1845, was published at the end of last year.

Another volume of the Edinburgh Astronomical Observations, that for 1843, has appeared since our last Report; and another is in progress, containing the rest of the observations of our late lamented Fellow, Professor Henderson, up to his demise in November 1844: appended to these will be the observations made since then up to July 1847, when the repairs of the building were commenced. These latter observations are not very numerous, being intended chiefly to secure as many moon-culminations as possible, especially those of the second limb: they will not, therefore, materially enlarge the present volume; and having been made with the instruments in precisely the same state as they were in Professor Henderson's time, may not improperly be included with his. But when the extensive repairs of the building were completed at last in 1848, such radical alterations were made in the instruments as to mark that epoch, rather than November 1844, as the commencement of the new series under the present astronomer.

Before, however, commencing with his own observations, Professor Piazzi Smyth wishes to publish an extra volume, giving a *résumé* of the whole of the planetary observations made by his predecessor; and especially a catalogue of stars, derived from the numerous excellent observations made between 1835 and 1847. There can be no doubt of the value of such a list, even of the larger and better known stars; and it becomes still more important with the smaller and unknown ones, which, forming so large a portion of the whole, would require the mean places of the stars to be accompanied in this publication with the constants for reduction to the apparent places, if this, the first Edinburgh catalogue, is to be of real and abundant practical use to working astronomers.

The preparation of such a work would, however, be a task of no small labour and time under the ordinary circumstances of an observatory establishment, consisting, as the Edinburgh one does still, of no more than an astronomer and one assistant; but a new circumstance has occurred, which makes the work almost impossible to be performed within any reasonable length of time, unless another assistant be added to the establishment.

The Edinburgh astronomer holds the position of Professor of Practical Astronomy in the University of Edinburgh, and is expected to lecture in the college on that subject for half the year; hitherto, however, this has never been done, even from the very foundation of the chair in 1770. With a mural circle, transit instrument, extra-meridian telescope, and some meteorological instruments to attend to, and with only one person to assist in all this, it is evident that Professor Henderson could spare no time from the observatory, if that work was to be done well; and he seems to have preferred to do the observatory half of his duties well, rather than that and the college half imperfectly; add to which, there was no apparatus by which the lectures might be illustrated, and no funds for supplying it either at the college or observatory.

Professor Piazzi Smyth—finding that public opinion was decidedly in favour of the lecturing being commenced, and being anxious to prove or disprove by actual practice the compatibility of the conjoined offices, or at least to try to do all that was expected of him, and having been further assisted by an opportune loan from our worthy and liberal Fellow, Dr. Lee of Hartwell, of a large quantity of instruments and apparatus—began a course of lectures on practical astronomy at the beginning of the present session. The success, as judged of by the number of students being more than was expected, seems encouraging. But after three months' trial of his new duties, and having three months more to accomplish before the session terminates, the Professor feels sure that a similar employment every year must materially injure the observatory, and that there is danger of its subsiding into little more than an educational establishment, unless he has additional assistance in carrying on the work of observing and computing on the Calton Hill.

At the observatory of Durham, Mr. Carrington, of Trinity College, Cambridge, was appointed astronomical observer in October 1849. From thence to May 1850, the principal work was done in the meridian. Since that time equatoreal work has been almost exclusively followed, as the most suitable occupation of a minor observatory. The results have from time to time appeared in our *Notices*. A chronometric comparison of longitude is now carrying out, and during 1851 the asteroids will be carefully followed. It has been suggested that it may soon become desirable to prearrange some division of labour in the case of the asteroids; and the Council think it advisable that this suggestion should be known and discussed.

Recent and satisfactory information has been received from Mr. Maclear. Now that the laborious and dangerous service of the measure of arc of the meridian is finished, the duties of the observatory of the Cape of Good Hope have resumed their natural course. Among the memoirs which were briefly announced in the *Monthly Notice* of December, is a full and particular report of Mr. Maclear's proceedings up to last July. It is not necessary here to enter into any detail with respect to this valuable document, as it will very speedily come before the world in a proper shape. The committee on Mr. Maclear's memoirs reported, that they would be a desirable acquisition to our quarto volume, but that it was not prudent nor our practice to print the work of a *public establishment* at the expense of the Society. The Astronomer Royal undertook to bring the matter before the Lords of the Admiralty, who consented with their usual liberality to defray the cost. We have many times had cause to bring the judicious kindness of their lordships prominently before you; and we may, perhaps, be allowed to remark (if any non-astronomer should be disposed to cavil at the gift), that the public thereby gains a guarantee for the sufficiency of the matter, a competent superintendence for the publication, and a wider circulation than could otherwise be commanded: all which is a carrying out, at no extravagant cost, the principal object for which the Cape Observatory was founded and is kept up. We think that the confidence thus shown in us is exceedingly gratifying, and we trust that you will feel so too. No time will be lost in passing Mr. Maclear's memoirs through the press, as part of the twentieth volume; and they will appear in a separate form very shortly. Mr. Maclear has sent, still more recently, a very valuable series of observations for determining the parallax of *α Centauri*. He has undertaken to re-examine the southern stars of the British Association, which are still very imperfectly known beyond the moderate number observed by Fallows, Johnson, and Henderson, and we have received two contributions to this inquiry.

It will be seen from the December *Notice*, that a somewhat similar revision of the southern heavens forms a large part of Lieut. Gilliss' stock-work during his residence in Chile. We wish the zealous director of this spirited expedition all the success he assuredly deserves.

We have not as yet received much information directly from Madras, but yet enough to prove that Captain Jacob is zealously and actively employed in his vocation. He is, among other things, engaged in examining and perfecting a catalogue of those stars which are best observed in his latitude. This is, of course, a long and heavy piece of duty, and perhaps the meridional instruments at Madras are not of the highest class,* but careful observations can always be made to furnish good results. Captain Jacob is of opinion that his geographical position naturally suggests planetary observation, and that with a large reflector on the Nilgherry Hills he would be more favourably placed for such observations than any one else. An application has been made to the East India Company for this purpose, but as yet without success. In the meantime Captain Jacob is making, from his own resources, a reflector of 2-feet aperture, to be equatoreally mounted with clockwork, so that he will be equipped for the service if he should obtain leave to execute it. Captain Jacob is also actively engaged in the measurement of *α Centauri* and other double stars, and in the computation of their orbits. His own large refractor by Lerebours is mounted equatoreally, and in a temporary manner, on the roof of his house, but it is probable that this instrument will be added to the observatory.

The observatory of Liverpool has figured very conspicuously in the records of our proceedings in the past year, and has fairly and honourably earned its European reputation. In the determination of extra-meridian phenomena, which do not fall within the range of a wire-micrometer, the Liverpool equatoreal is, we believe, at present unmatched. Such is the truth and steadiness of the mounting, that Mr. Hartnup can almost always employ stars of comparison from the Greenwich 12-year catalogue, and thus produce *at once* complete and accurate determinations. It must be avowed that the manipulation of this instrument is exceedingly laborious; but this is not a weighty obstacle to a skilful and zealous observer. We have great satisfaction in repeating the opinion expressed in the Report of last year, that "the determinations of the planets and comets made at this observatory would do credit to any establishment and to any instrument."

Last year Mr. Hartnup was a good deal engaged in assisting Professor Bond in his interesting chronometrical determination of the longitude of Cambridge observatory, U.S. "The final mean from 175 chronometers, duly reduced, &c., makes this longitude $4^h\ 44^m\ 30^s{\cdot}1$ west of Greenwich," a result which is probably not 1^s in error. Professor Bond hopes to obtain a still more accurate result, as the observations seem to indicate errors which may perhaps be eliminated by still greater precautions. The Professor proposes "to provide during the winter about 36 of the best chronometers, to have them thoroughly tested in temperature and well adjusted in

* Would it not be possible to procure for Madras the instruments of Lucknow, as that *observatory is to be* abandoned?

every respect, and to commence the exchanges between Cambridge, U.S., and Liverpool about June 1, 1851; to secure a separate state-room on board the steamer, and to have a competent person to take charge of the chronometers while on ship-board, to wind them up, note the differences every day, keep a journal of the temperature, barometric pressure, inclination of the vessel, and in short to attend to every particular which may be considered likely to affect their rates on ship-board." The Professor, in very handsome language, thanks Mr. Hartnup for his former co-operation, and requests its continuance in the new series.

Mr. Johnson has furnished Mr. Hartnup with a list of thirty-eight double stars, which he wished to have observed by the wire-micrometer, &c. of the Liverpool equatoreal, for comparison with measures made by the Oxford heliometer. Bad weather and the observation of the small planets have hitherto prevented Mr. Hartnup's observations extending beyond fourteen of these objects, but he purposes taking the matter up again as early as possible.

Besides the astronomical and chronometrical departments, the Liverpool Observatory is well supplied with meteorological instruments, and Mr. Hartnup has recently presented the results of five years' observations, ending December 31, 1850, to the Literary and Philosophical Society of Liverpool, who have requested permission of the Town Council to be allowed to publish the same.

Chronometers are tested at the observatory, as already described in former Reports, and with better means than any establishment, except Greenwich, enjoys. The assignment of the rate which corresponds to various temperatures enables any careful person to correct the defective compensation of his timepiece without sensible error, and must add very greatly to the accuracy of its indications. We trust that the importance of this part of the Liverpool Observatory will be felt more and more. It is a positive crime to neglect any feasible mode of increasing the security of navigation; and this is one which scarcely occasions any extra trouble.

We should be glad to learn that other ports had followed, even a long way off, the example of Liverpool, and enabled the seaman to prove the goodness of his chronometers, and to learn their errors and rates with scrupulous exactness. Southampton is at present furnished with Greenwich time by Mr. Drew, and possibly a similar advantage may be found elsewhere; but for perfect security and satisfaction, a regular establishment and observer are required, and this may be on a very modest scale, yet perfectly effectual.

The observatory of Mr. Cooper, of Markree Castle,—undoubtedly the most richly furnished private observatory known,—is worked with great activity by Mr. Cooper himself and by his very able assistant, Mr. Andrew Graham. It is understood that this observatory is at present chiefly devoted to completing an extensive and accurate series of star charts. But Mr. Graham has also found time to introduce his planet *Metis* to the astronomical world. He is, so far as we remember, the only astronomer who has discovered a planet, and undertaken the computation of her orbit

and the correction of her irregularities. The accordance between his observations and his last set of *Elements* shows that *Metis* is already amenable to her master's hand.

The observations for restoring the Standard Yard, and for determining a large number of accurate copies, have been pursued with some activity and with tolerable success; though, as usual, not without contrarieties. Having obtained what seemed a very close approximation to the imperial standard, Mr. Sheepshanks, with the aid of Mr. William Ellis and Mr. William Simms, junior, had many bars divided and compared in the course of last summer, the season most favourable for the operation. For the earlier comparisons a bar was used, in which the divisions were made, not by cuts or scratches, but by slightly separating the two halves of a cylinder split down the axis, which cylinder was inserted at each end of the bar. The improvement, however, made in the illumination showed that this kind of division was not practically required, and a bar was selected (one temporarily marked 12), which, according to the existing data, was sensibly equal to the lost standard. All the other observations of 1850 were made with No. 12 as the term of comparison, and No. 12 was itself carefully compared with Kater's Royal Society's Scale, and with Colby's Iron Bars, 1 A and 2 A. These last comparisons, which were exceedingly discordant, seemed to show that Bronze 12 was $= 36^{\text{in}}{\cdot}000048$ of the Imperial Yard.

As this was, on the whole, as good a result as the subject deserved (for it must be kept in mind that there is no accurate determination connected with the lost imperial yard, nor any trustworthy copies of it), all the observations were reduced in agreement with this value of Bronze 12; most of the bars, indeed, were compared directly with it. The previous term of comparison, viz. the bar with the split cylinder division, having been compared carefully with No. 12, it was believed that the bars were fairly determined *inter se*, though there might still be a little doubt as to their exact relation to the lost standard; if, indeed, an exact relation can be said to exist towards so uncertain a *modulus*.

In the course of these observations, bars of many kinds of metal were carefully measured, and in some, the expansions for small changes of temperature nicely ascertained. Copper of different sorts, cast iron, cast steel, wrought iron, both Swedish and Low Moor, were all employed. It was conceived, in fact, that the problem was solved; and that little remained but to select the bars required for the New Parliamentary Standards, to follow out some of the expansion experiments in greater detail, to recompare, perhaps, if it were required, the definitive yard with the copies of the lost imperial yard, and to prepare properly tested thermometers.

The first thing done after last vacation was to pick out a few yards, which were sharply divided, floated evenly in mercury, and came nearest in length to the imperial yard, according to the presumed value of Bronze 12. Some of these had been compared

appointment of their distinguished ex-President, Sir John Herschel, to the post which is so firmly associated with science in the minds of Englishmen by its connexion with the name of Newton. It is to be hoped that the duties of the office, even if rendered more than usually onerous by the necessity of originating and superintending necessary reforms, will not entirely withdraw its occupant, or at most but for a time, from astronomy; and in this persuasion the Council feel assured that the Society will offer its hearty congratulations, as well to Sir John Herschel as to the branch of the public service for which his talents are secured.

The increased attention which has been paid within the last few years to the construction of meteorological instruments, to their examination, and determination of index-errors before use, together with the uniform reduction of the observations, have induced many of our Fellows to take regular meteorologic observations, and series of such observations are now taken at almost all astronomical observatories. Thus a number of good observers have sprung up in different parts of the country, who all work upon one plan. On the 4th of April, 1850, a meeting of gentlemen, all Fellows of this Society, was held at Hartwell House, the residence of Dr. Lee, for the purpose of taking into their consideration the best means of still further advancing meteorology; and the result of their deliberations was the establishment of a new Society, called the "*British Meteorological Society*," for the promotion of the science.

The announcement of this Society has been well received by the public; the number of its members at present exceeds 150, and it has already published forms for recording observations. Some tables for the reduction of observations have been contributed by its members. Its Secretary furnishes a report upon the weather weekly to the *Institute* Journal; and quarterly accounts are furnished to the Registrar-general, to the *Philosophical Magazine*, and to the *Engineers' and Architects' Journal*.

Mr. Bishop's Ecliptical Charts for hours 2 and 3 of right ascension are in the engraver's hands, and will be published immediately. They contain every star, to the 11th magnitude inclusive, within 3° of the ecliptic, north and south. The other charts will follow as rapidly as the weather allows of their completion; and it is hoped that the whole set of charts will be in the hands of astronomers in the course of the ensuing year.

From 1847 to 1850 inclusive, a year has not passed without an addition to our planetary list. During the last twelve months three small planets have been discovered,—a rate of increase in the known members of the solar system which can hardly be expected to continue very long. The methods necessary to be pursued in a search for planets are of a nature to be advantageously *practised only* after a long experience, whereby the observer

becomes intimately acquainted with the configurations of the telescopic stars, and has established a uniform system of magnitudes for his charts or zones: this is of the utmost importance, and only to be accomplished after a long course of observation. Hence, probably, arises the circumstance that eight of the new planets have fallen to the lot of three persons; for it is reasonable to expect that the success attending the labours of M. Hencke, who commenced the modern series of discoveries, will have induced many astronomers besides Mr. Hind and Dr. de Gasparis to enter the same field.

Of the three planets detected during the past year, the first was found at Naples by Dr. A. de Gasparis, on the 11th of May, and was immediately named *Parthenope* (in conformity with a suggestion of Sir John Herschel's), to commemorate the site of the discovery. It appeared like a star of the 9th magnitude, and was observed till the end of November. The *Berliner Jahrbuch* for 1853 contains an ephemeris of this planet for 1851, which Lieutenant Stratford intends to publish in the forthcoming volume of the *Nautical Almanac.* The period of revolution is found to be 1401 days, placing *Parthenope* between *Hebe* and *Astræa* in the order of mean distance.

The second planet was discovered on the evening of September 13th, by Mr. Hind, at Mr. Bishop's observatory in the Regent's Park, being the third member of the ultra-zodiacal group which has been detected by the system of examination of the heavens and the formation of charts at present pursued there. This planet has received the name *Victoria*, with a star and laurel-branch for its symbol. The period of revolution is about three weeks shorter than that of *Vesta*, or about 1303 days: consequently *Victoria* will follow the second of Mr. Hind's planets (*Flora*) in order of distance from the sun. At the time of discovery she appeared as a full 8th magnitude, but very rapidly grew fainter, and at present is not brighter than stars of the 11th class. Lieutenant Stratford has computed an ephemeris of this planet for the year 1851, which is to appear in the *Nautical Almanac* for 1854.

The *third* planet was found in the course of zone-observations at Naples, by Dr. A. de Gasparis, on the evening of November 2d. It was sensibly fainter than stars of the 9th magnitude, and has now become so small as to require a pretty exact knowledge of its position to distinguish it from the numerous stars of the same brightness. The elements, though of course imperfect at present, appear to place this planet between *Parthenope* and *Astræa*, the periodic time being 1496 days. M. Le Verrier, to whom was delegated the right of naming this planet, has called it *Egeria.* It will be remembered that Dr. de Gasparis found a small planet in April 1849, which received the name *Hygeia;* and in acknowledgment of these discoveries your Council have awarded to Dr. de Gasparis the gold medal of the Society.

The last year has been less prolific in comets than some of its predecessors, but there are yet *two* to be added to the catalogue.

On the 1st of May, Dr. Petersen, the zealous assistant of the late Professor Schumacher at Altona, detected a faint telescopic comet not far from the pole of the ecliptic, in a region of the heavens very well known to him, and close to the position where he had previously made a similar discovery. This comet became distinctly visible to the naked eye shortly before the perihelion passage at the end of the third week in July, and a great number of observations were obtained in Europe and America. The orbit does not sensibly differ from a parabola.

The second comet of 1850 had many discoverers; but priority is due to Mr. G. P. Bond, son of the director of the Cambridge Observatory, Massachusetts, who saw it on the 29th of August, a week previous to the first European observation by M. Brorsen, on September 5th. On the 9th it was found by M. Mauvais at Paris, and Mr. Robertson at Markree, and on the 14th by Dr. Clausen, at Dorpat in Russia. As in the former case, there is no sensible deviation from the parabola in the form of the orbit. The comet was visible till the beginning of November, but was never very conspicuous.

In addition to the comets of Petersen and Bond, we have to record the reappearance, under very gratifying circumstances as regards the prediction, of the periodical comet of Faye. Astronomers are indebted to Lieutenant Stratford for directing attention to this interesting body by the publication of an ephemeris, which enabled Professor Challis to discover and observe the comet with the Northumberland telescope in November last. The elements had been rigorously investigated by M. Le Verrier from the observations of 1843-4; and the perturbations due to planetary attraction having been calculated by the same mathematician, the perihelion passage was fixed for the 2d of April, 1851. The observations taken by Professor Challis confirm, in the most striking manner, M. Le Verrier's prediction, the correction to the mean motion necessary to bring about a perfect accordance between theory and observation being very minute. This circumstance is the more satisfactory, as there was no return of the comet prior to 1843 to guide the computer in his determination of the length of the major axis, as was the case with the celebrated comets of Encke and Biela. Hence the return of Faye's Comet has afforded a most gratifying proof of the progress we have made in the theory and practice connected with this department of astronomy. The facilities afforded in the correction of the elements, by M. Le Verrier's method of introducing a term exhibiting the alteration due to each from any probable correction of the mean diurnal motion, are worthy of remark, and have been exemplified in the present instance. This comet has also been observed by Mr. Bond at Cambridge, U.S.

Papers read before the Society from February 1850 *to February* 1851.

1850.

March 8. Note on Computing the Orbit of a Comet. Mr. Waterston.

Appendix to Note on Computing the Orbit of a Comet. Mr. Waterston.

Description of a small Equatoreal and Dome. Mr. Fletcher.

On the Star *Pollux*. Mr. Fletcher.

On the Transit of the Fourth Satellite of *Jupiter*. Mr. Lassell.

Proper Motions of 875 Stars of Greenwich Catalogue. Rev. R. Main.

April 12. Observations of Minor Planets. Mr. Hartnup.

On the late extraordinary Cold Weather. Dr. Forster.

On η *Argûs*. Mr. Spreckley.

Observations of Western Light. Mr. E. J. Lowe.

On the Comet of Long Period. Mr. Hind.

Addition to Note on 1830 Groombridge. M. O. Struve.

Notice of a Comet seen at Rio Janeiro. Mr. Curley.

On a Machine for calculating Corrections to Transit. Mr. Carrington.

On determining the Longitude by Observation of Moon's Altitude. Mr. Aske.

On the Phenomena attending the Disappearance of *Saturn's* Ring. Rev. R. Dawes.

Observations of Latitude of *Neptune*, and of a remarkable Appearance of *Jupiter*. Mr. Lassell.

Observations of *Hygeia*. M. Rümker.

May 10. Observations of *Mars*. T. Maclear, Esq.

Notes on B. A. Catalogue. Captain Jacob.

Errors in Shortrede's Logarithms. Mr. Galbraith.

Occultations of Stars by the Moon. Mr. Snow.

Observation of *Iris*. Mr. Hartnup.

On the further Reduction of Bessel's Zones. M. Weisse.

Observations of γ *Virginis*. Mr. Hartnup.

On the Comet of Pons 1818. Mr. Pogson.

Observations of Planets. Mr. Graham.

Notice of Errors in the *Histoire Céleste*. The Astronomer Royal.

Observations of Planets. Mr. Hartnup.

Observations of *Hebe*. M. Rümker.

Elements and Ephemeris of *Hygeia*. M. D'Arrest.

On the Reduction of Sidereal Time to Solar. Rev. J. M. Heath.

Comet Circular. Professor Schumacher.

On Adaptation of Calculations for Occultations at Greenwich to another Place. Professor Chevallier.

On the Calculation of slowly Converging Series. Sir J. Lubbock.

Continuation of Paper on Transit Regulator. Mr. Carrington.

On the Orbits of *α Centauri*, &c. Captain Jacob.

On the Weights to be given to the separate Results for Terrestrial Longitudes, determined by Observations of the Moon and Fixed Stars. The Astronomer Royal.

Graphical Mode of computing Excentric Anomaly. Mr. Waterston.

Observations of Petersen's Comet. M. Rümker.

June 14. Observations of Double Stars. Rev. W. R. Dawes.

On a Universal Reference Number for Star Catalogues. Mr. Drach.

On *γ Virginis*. Mr. Fletcher.

On an Instrument for correcting Transit Error. Rev. J. Challis.

Occultation of *Jupiter* by the Moon. Signor Secchi.

On the Star B.A.C. 535. Professor Johnson.

On the Longitude of George Town Observatory, U.S. Mr. Curley.

Elements of Petersen's Comet. Mr. Pogson.

Discovery of *Parthenope*. Signor de Gasparis.

Observations of *Parthenope* and Petersen's Comet. Mr. Hind.

Observations, Elements, &c., of Petersen's Comet. Professor Schumacher.

Observations of Petersen's Comet. Professor Chevallier.

Observations of Petersen's Comet. Mr. Boreham.

Various Observations. M. Rümker.

Various Observations. Mr. Hartnup.

Various Observations. Professor Chevallier.

On a Rectification of the Altitude and Azimuth Instrument. The Astronomer Royal.

Elements of Petersen's Third Comet. Mr. Breen.

Occultation of *Jupiter* by the Moon, May 19, 1850. Captain Shea.

Nov. 8. Note of Modification of a divided Eye-piece. The Astronomer Royal.

Ephemeris of Petersen's Third Comet. Professor Schumacher.

Notice of Right Ascension of certain Stars, &c. Lord Wrottesley.

Observations of Petersen's Third Comet. Mr. Boreham.

Measures of *ε Boötis*. Mr. Fletcher.

Observation of 33239, 33244, *Histoire Céleste*. Professor Smyth.

Observations of *Juno*, *Iris*, and Petersen's Third Comet. Mr. Carrington.
Elements and Ephemeris of Petersen's Third Comet. Professor Schumacher.
Discovery of Second Satellite of *Neptune*. Mr. Lassell.
Observations of *Parthenope*. Mr. Lassell.
On the Comet seen by Mr. Jenkins. Mr. Horner.
Notice respecting Lunar Investigations. Professor Hansen.
Observation of Petersen's Third Comet. Lieut. Maury.
Observation of Petersen's Third Comet. Rev. J. B. Reade.
On the Teeth and Pinions to reduce Sidereal to Solar Time. Mr. Henderson.
Letter to the Royal Astronomical Society. Sir John Ross.
Observations of *Hygeia*, *Neptune*, &c. Mr. Hartnup.
Elements of *Metis*. Mr. Graham.
Observations of Planets and Comets. Mr. Carrington.
Estimated Places of a Comet. Captain Shea.
Discovery of *Victoria*, and Observations. Mr. Hind.
Notice of Discovery of a Comet (Bond's). Mr. Graham.
Elements and Ephemeris of Bond's Comet. Mr. Graham.
Notice of Observations of Bond's Comet by MM. Mauvais and Graham. The Astronomer Royal.
Observations of Petersen's Third Comet. Professor Bond.
Elements and Ephemeris of Brorsen's Fourth Comet (Bond's). M. Rümker.
On the Means of getting Greenwich Time at Southampton. Mr. Drew.
On some remarkable Appearances of Self-luminousBodies. Rev. W. Read.
Elements of *Victoria*. M. Rümker.
Observations of *Victoria*. Professor Smyth.
Erratum in Argelander's Star Zone, 5°, No. 26. Mr. Boreham.
Observations of *Victoria*. M. Rümker.
Account of a New Variable Star. Mr. Hind.
Elements and Observations of *Victoria*. M. Rümker.
Observations of Bond's Comet. Professor Bond.
Discovery of a Comet, and Elements. Professor Bond.
Dec. 13. Elements of *Victoria*. Messrs. Breen and Villarceau.
Discovery of *Egeria*. Signor de Gasparis.
Observations of *Flora*, *Neptune*, &c. Mr. Hartnup.
Observations of *Egeria* and *Victoria*. Mr. Hartuup.
On Observations of *Neptune* as a Fixed Star. Mr. Hind.
Micrometrical Measures of Double Stars, &c. Mr. Maclear.
Note on 70 *Ophiuchi*. Mr. Fletcher.
On the Nomenclature of Stars in B.A.C. Mr. Woollgar.
On the Influence of Heat on the Dispersive Power of Liquids. Rev. T. P. Dale.

On the Ring of *Saturn*. Rev. W. R. Dawes.
Observations of *Victoria*. Mr. Boreham.
On the Longitude of Stonyhurst. Rev. A. Weld.
On Black Discs for Drawings of Double Stars, &c. Mr. De la Rue.
On a Method of computing the Corrections for clearing the Lunar Distance. Mr. J. Riddle.
Observations of *Victoria* and *Egeria*, and Ephemeris of *Egeria*. M. G. Rümker.
Observations of *Victoria*, *Metis*, &c. Professor Challis.
Supplement to Paper on the Regulation of Clock-work for effecting the uniform Motion of an Equatoreal. The Astronomer Royal.

1851.
Jan. 10. Elements, &c., of *Metis*. Mr. Graham.
Ephemeris of *Egeria*. M. Vogel.
Letters to Captain Smyth on various Subjects. MM. Everett and Gilliss.
Second List of Stars observed in Right Ascension from B.A.C. Lord Wrottesley.
Observations of *Victoria* at Washington, U.S.
Corrected Ephemeris of Faye's Comet. M. Le Verrier.
Speculations respecting Satellites. Mr. Cullimore.
Ephemeris of *Metis*. Mr. Graham.
Mean Place of Hind's Star. M. Rümker.
Elements of *Egeria*. M. G. Rümker.
Observations of *Victoria*, *Metis*, and *Egeria*. Mr. Hartnup.
Suspected Division of Outer Ring of *Saturn*. Mr. Lassell.
Diagrams of *Saturn* with Explanations. Rev. W. R. Dawes.
Note on Name of *Victoria* given to his Third Planet. Mr. Hind.
Letters on *Saturn's* Inner Dark Ring. MM. Lassell and Hind.
Letter respecting his Operations. Mr. Maclear.
Report from Observatory Cape of Good Hope. Mr. Maclear.
On the Comet of 1843. Mr. Maclear.
Description of the Cape Equatoreal. Mr. Maclear.
Remarks, &c., on Southern Stars in B.A.C. Mr. Maclear.
Second Series of Southern Stars in B.A.C. Mr. Maclear.
Observations of Satellite of *Neptune* and of *Jupiter*. Mr. Lassell.
Drawing of Solar Spots. Mr. Prince.

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J. J. Weld, Esq.
Mr. J. Williams.
J. W. Woollgar, Esq.

Address delivered by the Astronomer Royal, President of the Society, on presenting the Honorary Medal of the Society to Dr. Annibale de Gasparis.

It is now my duty, Gentlemen, to announce to you that the Council have awarded the Medal of the Society to Signor Annibal de Gasparis, for the discovery of the three planets, *Hygeia*, *Parthenope*, and *Egeria*. The nature of these discoveries scarcely allows of any very elaborate commentary, yet perhaps a few remarks upon the methods by which these and other planets have been found may not be misplaced on the present occasion.

Seventy years since, the only planets known to men of science were the same which were known to Chaldean shepherds thousands of years ago. The "five other wandering orbs" of Milton, whose number Kepler once conceived to be fixed by the immutable laws of necessity, were still the only recognised wanderers in the sky. Although the notion of a fatality in the precise number had doubtless passed away, yet the impression produced on men's minds by the unbroken recognition through many ages of five and only five planets, possessed nearly the same force. The discovery of a new veritable planet seems to have given rise to the same kind of emotions as would be produced now if we found a class of animals possessing a new kind of sense; as a perception of magnetism, of photogenic

radiation, or of polarization. This discovery was made by the elder Herschel; and it was truly the fruit of accident, occurring in the course of sidereal researches, in which the discovery of planets does not appear to have been contemplated. Let me not, however, be understood as disparaging from the claims of Herschel to the fame which he acquired. Another person might have seen the new star; but scarcely another person would have instantly remarked its peculiarity of appearance, would have interrupted his sweep in order to follow it, and would have immediately determined its place so well as to be able in a short time to see that it was a moving body. Acute senses, rapid judgment, and prompt action, were necessary; and they were successful. And the innovation thus made in the subjects of thought for the speculative astronomer appears to me the greatest that had been made since the establishment, among men of science, of the doctrine of the movement of the earth.

The spell was now broken; and the accidental discovery of another planet (*Ceres*) at the beginning of the present century, excited therefore little emotion on the mere ground of the discovery of a new planet. But it was interesting on another ground; that the position of the new planet, in respect of distance from the sun, corresponded well with an empirical law, which was generally founded on the known distances of the other planets, but which required for its completeness the interposition of another planet at the newly-found distance. This interest was increased when, upon examination of stars seen near to *Ceres*, it was discovered that one of these was moveable, and that it was also a planet (*Pallas*), with mean distance from the sun differing very little from that of *Ceres*. The idea was promulgated that these two might be fragments of one great planet, and that possibly other fragments of the same planet might be found; and it was reasonably inferred that if these fragments had been formed by one great explosion, the orbit of every one of the fragments must (except as affected by perturbations) continue to pass through the point of explosion; and, therefore, if we noted in the heavens the point of intersection of the orbits of *Ceres* and *Pallas*, and kept up a constant watch on the neighbourhood of that point, we must infallibly discover all the other fragments. That limited tract of the sky was like a pass in a mountain-chain; however much the travellers might wander over the plain in their approach to it, they must necessarily all traverse that narrow gate; and *there* was the place where a detective police might be stationed with a good chance of arresting suspicious vagrants. And now the process for the discovery of planets assumed a new and a systematic form. A confederation of German astronomers, mainly under the direction of the celebrated Olbers, undertook and maintained for many years a regular watch of the portions of the heavens indicated as the planet-portals. *Juno* and *Vesta* were thus discovered. And so steadily did Olbers keep up his examination, that he was at last able to assert that no other new planet had passed the guarded

space from 1808 to 1816. This assertion must, of course, be understood as limited by the powers of the telescope which he used, and which was much inferior to those employed in more modern researches.

It was, apparently, amid the reflections naturally suggested by the arduous labours of these still somewhat isolated inquiries, that the idea of more completely examining and recording the appearance of the heavens at a definite time grew up. On 1825, Nov. 1, the Berlin Academy issued its celebrated invitation to astronomers, to co-operate in forming maps of the heavens within certain limits of declination. The probability of finding planets by this means was distinctly pointed out in that document. The response to the invitation has been very satisfactory, though even yet not perfectly complete; and it is impossible to overrate the effect which it has had in promoting the discovery of planets. This it has done, not simply by the direct use of these charts for comparison with the heavens, although the first planets of Hencke, Hind, and De Gasparis, as well as another to which I shall shortly allude, were thus discovered; but also by the stimulus which they have given, and the example which they have afforded, for the formation of other more accurate charts (for the most part unpublished), such as those by which the later planets of Hind and De Gasparis, and that of Graham, were found.

In the meantime another planet was found, under circumstances probably the most extraordinary that have ever presented themselves in the history of science. It is not my intention here to enter upon the details of the discovery of *Neptune*; but there is one circumstance connected with it, related to the matter of which I have just spoken, to which I may properly allude. It will at least serve to show how strongly I have felt the disadvantage of not possessing charts like the Berlin maps, and how vividly others have experienced the satisfaction of having them at hand in the time of need. It may be in the recollection of some persons, who have read the contribution to the history of that discovery which I communicated to this Society, that when an approximate place had been indicated for *Neptune* by the theoretical investigations of Adams and Le Verrier, I took the liberty of urging on my friend Professor Challis the probable advantage of examining a certain tract of the heavens, and I at the same time offered some suggestions as to the way of making the examination. In these I distinctly pointed out that the Berlin maps applying to the tract in question were not completed, that only a small corner of one of them was available, and that it was necessary to contemplate the very serious labour of two or three complete examinations. But at Berlin the state of preparations was different. The chart relating to the Neptunian region was just completed by a German astronomer; I am not quite certain whether the proof or one of the earliest printed copies was in the hands of Dr. Galle: a very rapid glance on each part sufficed to show whether any new object had or had not crept into that tract; and a discovery was made with

the assistance of the chart in a few minutes which, without it, might have employed months.

It thus appears that planets have been discovered in three different ways: by accident, by examination of the heavens, as suggested by the investigations of physical astronomy, and by systematic comparison of the visible state of the heavens with the state as recorded in charts. But the number of discoveries made in the different ways is very different: three in the first, one in the second, and eleven in the third. We are justified thus in asserting that there is one method which is peculiarly the proper one for the search for planets; and the employment or non-employment of this method must in some measure affect our estimation of the judgment exhibited by the person who is engaged in the search.

The three planets of Signor de Gasparis were all discovered in this way: the first (*Hygeia*) on 1849, April 12, by comparison with the Berlin maps; the second (*Parthenope*) on 1850, May 11, it is believed in the same manner; the third (*Egeria*) on 1850, November 2, by comparison with the ecliptic charts constructed by Signor de Gasparis from his own observations.

Let me now for a moment invite your attention to the importance of these discoveries. And this, perhaps, can best be illustrated by analogy. When the young naturalist enters first upon extensive examination, not only of the genera and species, but also of the habitats of animals, nothing is more striking to him than to find that life, implying also organisation and order, in some form or other abounds everywhere. The discoveries of astronomy lead us to a similar conclusion. The fields occupied by the specific subjects of discovery are broader, the exploration of their individual characteristics is less accurate; but the same general impression rises on us, that planetary life, so to speak, abounds everywhere. Where, fifty years ago, not a single planet was known to exist, a group of thirteen is now recognised. Of their organisation we can yet say nothing, but of the order with which they follow the laws of motion, inferred from the investigation of the older planets' motions, we have positive assurance. And no one, who remarks how more extended discoveries have followed more improved means of observation, can resist the belief that as we still go on improving our instruments we shall still go on finding more planets, till space, in our solar system at least, may appear, in reference to what was formerly known, comparatively full of these travelling bodies.

I am sure, Gentlemen, that your hearty approval will accompany your Council's award of the Society's Medal for labours judiciously and successfully directed in a course of researches on such an important object. And I trust that our award will be acceptable to Signor de Gasparis, as an evidence that we are not slow in learning and not ungenerous in estimating the efforts of a foreigner in promoting the science which we call peculiarly ours. There is another circumstance which I hope will increase his gratification. The testimony of the Society's respect will be delivered by [illegible]

its officers, who has himself laboured in the same cause and with similar success. And the publication of our adjudication, and of the instrumentality by which we carry it into execution, will serve to convince the world, if conviction were necessary, that neither national nor personal rivalry disturbs the appreciation of labours ably directed to a worthy object.

(*The President, addressing himself to Mr. Hind, Foreign Secretary of the Society, as proxy for Signor de Gasparis, continued as follows*) :—

I request you to deliver this Medal, in the name of the Society, to Signor de Gasparis; to express to him the respect entertained in this country, and by none more than by yourself, for his labour, his judgment, and his success; and to convey to him our wishes for the continuance and increase of his reputation in the science to which he has so ardently devoted himself.

The Meeting then proceeded to the election of the Officers and Council for the ensuing year, when the following Fellows were elected :—

President :

J. C. Adams, Esq. M.A. F.R.S.

Vice-Presidents :

G. B. Airy, Esq. M.A. F.R.S. Astronomer Royal
Rev. Robert Main, M.A.
Lieut. Henry Raper, R.N.
Captain W. H. Smyth, R.N. K.S.F. D.C.L. F.R.S.

Treasurer :

George Bishop, Esq. F.R.S.

Secretaries :

Augustus De Morgan, Esq.
Captain R. H. Manners, R.N.

Foreign Secretary :

John Russell Hind, Esq.

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J. W. Woollgar, Esq.

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ROYAL ASTRONOMICAL SOCIETY.

Vol. XI. *March* 14, 1851. No. 5.

J. C. Adams, Esq., President, in the chair.

Warren De la Rue, Esq., St. Mary's Road, Islington;
R. C. Carrington, Esq., Observatory, Durham; and
Thomas Tate, Esq., Amber Cottages, Twickenham,
were balloted for and duly elected Fellows of the Society.

The life of Professor Schumacher in the Annual Report is kept standing in type, to receive corrections and additions. Professor Struve, who furnished a principal part of the facts and dates, proposes to annex an estimate of the *influence* which the exertions and character of the deceased have had on the progress of modern astronomy. This has been delayed unavoidably from the pressure of urgent business.

Astronomische Nachrichten.

The Editor of the *Monthly Notices* suggests that it is a proper time to call attention to this invaluable publication, which has now become an astronomical necessity. We cannot contemplate the cessation of the work without dismay, and as it is not as yet known whether the support of Government will be continued, or to what extent, all well-wishers to the progress of astronomy must contribute their assistance. By such a combination, success under the new Editors, Professor Hansen and Dr. Petersen, may be ensured. From inquiries which have been made, it appears that the numbers which compose a volume can be sent free *by post* to England for 11*s.* 6*d.* The Editor proposes to open a list for subscribers at that price, requiring, however, *prepayment*, to avoid trouble and correspondence. Any Fellows of the Society, or indeed any person caring for the science, who forwards his name and address and subscription for the current volume, will receive the numbers free, and by post, as they are published.

The payments will be received by the Assistant Secretary, Mr. Williams, and the Editor will transfer the amount to Dr. Petersen.

It is possible that some gentlemen in America might wish to avail themselves of this arrangement, and it is presumed that an additional penny would pay for the sea passage of each number, if the convention between England and America includes foreign

serial publications. In this case, it would be easy to calculate the additional expense, and perhaps some friend of astronomy in the United States would charge himself with the arrangement. That the *Astronomische Nachrichten* MUST be supported, and, if possible, extended, needs no demonstration.

The *Nautical Almanac* for 1854 has recently been published. Besides the usual information, it contains ephemerides of all the newly-discovered planets for 1851, except *Egeria*, and co-ordinates of the sun for 1851, 2, 3.

Note by the Astronomer Royal.

In an oral address to the Society, "On Instruments adapted to the Measure of small Meridional Zenith Distances," delivered at the meeting of 1849, June 8 (*Monthly Notices*, vol. ix. No. 8), I alluded (page 184, last paragraph) to the opinion of Bouguer, on the impropriety of inferring the certainty of a mean result from the mere accordance of individual results. The more forcible expression, however, of this opinion, which I had in my mind, is that of Svanberg, in the account of the modern measure of an arc of meridian in Lapland; and the sentiment is so important and so well expressed that I think it desirable to place it before the Society in the very words of Svanberg:—

"L'accord d'un grand nombre d'observations ne suffit pas toujours pour en prouver la bonté, à moins qu'on ne se soit assuré auparavant, par l'examen le plus scrupuleux de l'instrument dont on s'est servi, qu'il n'y ait eu dans celui-ci aucune cause qui ait agi constamment dans le même sens pour en altérer tous les résultats."—Svanberg, *Discours Préliminaire*, p. xxvi.

Letter to the President and Council of the Royal Astronomical Society, from Mr. Dawes, with a framed Drawing of Saturn.

"Gentlemen,—I have the pleasure of presenting to the Royal Astronomical Society the accompanying picture of the planet *Saturn*, which I hope the Society will do me the favour to accept. It is specially intended to exhibit the appearance of the interior obscure zone, or ring, as discovered by me on Nov. 29th, 1850.

"As the picture refers only to the discoveries of that night, the indications I have since noticed of a division of the obscure ring into two are, of course, not introduced. Viewed at a distance of about fifteen feet, it very fairly represents the appearance of the planet in my telescope at the above-mentioned date.

"I have the honour to be, &c.

"WM. R. DAWES.

"*Wateringbury, 5th March, 1851.*"

VICTORIA.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1851.	Greenwich M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	Compd—Obsd. R.A. s	Compd—Obsd. N.P.D. ″	Star of Comp.
Feb. 8	7 21 54·1	1 18 5·32	80 6 30·6	−0·33	+5·1	B.A.C. 288
20	7 58 24·1	1 37 58·38	78 39 54·3	0·09	6·4	— 488
23	7 18 40·2	1 42 58·44	78 18 20·7	0·08	5·7	— —
Mar. 3	8 19 12·5	1 56 39·65	77 20 5·9	−0·07	+7·4	— —

The parallax and computed places were deduced from M. Yvon Villarceau's ephemeris, published in the *Monthly Notices*, vol. xi., No. 3.

The following are the assumed *mean* places of the stars of comparison for 1851·0, derived from the Greenwich 12-year Catalogue.

	R.A. h m s	N.P.D. ° ′ ″
B.A.C. 288	0 55 12·86	82 54 47·81
— 488	1 29 12·33	78 37 19·45

The following results are derived by comparison of the *Observations*, p. 54, with the ephemeris of M. Villarceau:—

	Compd—Obsd. R.A. s	Compd—Obsd. N.P.D. ″
1851, Jan. 12	−0·59	+7·4
— — 22	−0·49	+4·2
— — 23	−0·32	+7·0

EGERIA.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1851.	Greenwich M.T. h m s	R.A. h m s	Log. $\frac{p}{P}$	N.P.D. ° ′ ″	Log. $\frac{q}{P}$	Star of Comp.
Feb. 8	8 5 8·6	2 6 27·11	+8·320	72 32 5·8	−9·7831	B.A.C. 650
	8 20 7·3	27·95	8·365	0·0	9·7876	— —
23	8 9 3·0	2 25 30·02	8·545	70 13 65·3	9·8056	— 707
	8 39 1·3	31·81	8·578	50·0	9·8217	— —
Mar. 3	9 9 51·3	2 36 57·41	8·596	68 59 30·9	9·8763	— 808
	9 24 50·3	58·42	+8·602	24·7	−9·8834	— —

The observations are corrected for refraction.

The corrections to be applied for parallax, in time and arc, are represented by p and q. P is the equatoreal horizontal parallax.

The following assumed *mean* places of the stars of comparison for 1851·0 are derived from the Greenwich 12-year Catalogue:—

	R.A. h m s	N.P.D. ° ′ ″
B.A.C. 650	1 59 35·50	72 40 56·86
— 707	2 9 50·73	70 47 26·13
— *808*	2 30 21·83	68 41 7·80

DURHAM. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1850.	Green. M.T. h m s	App. R.A. h m s	Log $\frac{p}{P}$	App. N.P.D. ° ′ ″	Log $\frac{q}{P}$	No. of Comps. R.A.	N.P.D.	Set.
Nov. 21	7 15 48·3	1 43 30·49	−8·381	81 18 76·7	−9·866	24	8	1
	12 39 21·1	19·20	+8·425	34·3	9·869	18	6	2
27	12 21 42·9	39 9·14	+8·445	80 58 11·8	9·869	24	8	3
28	11 9 24·5	38 35·08	+8·271	54 32·0	9·859	24	8	4
Dec. 6	7 20 35·3	34 54·11	−8·126	20 80·0	9·852	8	8	5
	10 8 1·9	51·70	+8·165	44·5	9·852	20	7	6
8	11 28 21·2	34 12·52	+8·435	10 55·8	9·864	23	8	7
9	7 8 27·3	33 59·47	−8·120	80 6 57·2	9·850	23	8	8
	11 25 23·7	55·99	+8·434	7·3	9·864	15	5	9
12	8 52 54·8	33 19·03	+7·805	79 51 17·0	9·845	24	8	10
19	12 5 37·5	32 53·00	+8·551	10 57·8	9·877	15	5	11
20	8 30 3·2	32 55·77	+7·900	79 5 45·6	9·839	24	8	12
21	10 49 14·4	33 1·37	+8·462	78 59 4·4	9·860	16	8	13
23	8 40 53·2	33 15·58	+8·073	46 67·1	9·839	24	8	14
	10 37 22·7	16·36	+8·455	34·2	9·858	18	6	15
26	8 14 20·3	33 50·41	+7·961	27 47·9	9·835	24	8	16
27	9 59 32·7	34 6·43	+8·408	20 44·2	9·850	24	8	17
28	10 15 50·1	1 34 23·17	+8·451	78 13 54·1	−9·853	18	6	18

"P is the equatoreal hour parallax in seconds of arc, and *p* and *q* are the corrections in seconds of time and arc respectively."

Assumed *Apparent* Places of the Stars of Comparison.

Name and Authority.	App. R.A. h m s	App. N.P.D. ° ′ ″	Set.
Weisse, 1^h, 743	1 41 19·77	81 28 9·6	1
— 801	44 45·90	81 9 8·8	2
Anonymous, 9·10 mag.	41 23·45	81 3 38·8	3
Weisse, 1^h, 756	42 25·67	80 55 55·1	4
— 633	34 43·77	80 30 34·1	5
— 526	30 25·24	80 15 3·5	6
— 526	30 25·23	80 15 3·6	7
— 555 *	31 34·47	80 5 8·4	8
B.A.C. 542, Green. 12-y^r Cat.	39 14·97	79 54 17·3	9
— — —	39 14·95	79 54 17·4	10
Anonymous, 9th mag.	33 43·33	79 7 32·9	11
— —	33 43·32	79 7 33·0	12
Weisse, 1^h, 569	32 25·51	78 52 41·0	13
B.A.C. 490, Green. 12-y^r Cat.	29 44·79	78 41 3·9	14
— 488, — —	29 12·00	78 37 23·8	15
— 488, — —	29 11·96	78 37 24·0	16
Weisse, 1^h, 539	31 15·73	78 19 19·0	17
— —	1 31 15·72	78 19 19·0	18

Nov. 21. Hazy. Planet considered to be of 10th magnitude.

Nov. 27. Weisse, 1^h, 718 was missing. The place of the star used depends upon Weisse, 1^h, 756. It has a small companion n. p.

Dec. 9. Set 8. Weisse, 1^h, 555 is in error in right ascension. After comparing it with No. 526, I have diminished its right ascension by $14^s \cdot 00$. The north polar distance agreed with the catalogue.

Dec. 12. Planet dimmed by haze, but the measures good.

Dec. 19. Moonlight nearly overpowering the planet. I could hardly afford to illuminate the wires sufficiently.

Dec. 20 and 21. The same circumstances.

Dec. 23. The second set on this night is the better one; the telescope's unsteadiness giving trouble in getting set 14.

Dec. 27. Patches of vapour, but the planet brighter and better seen than of late.

Dec. 28. High wind. Several other comparisons made and rejected on examination.

HAMBURG. Equatoreal. (M. C. Rümker.)

1851.	Hamburg M.T. h m s	Observed R.A. ° ′ ″	Observed Decl. ° ′ ″	No. Obs.
Feb. 6	8 29 46·2	31 2 14·6	+17 9 32·9	7
21	8 17 54·6	35 41 24·0	19 27 18·3	12
23	7 28 13·3	36 21 34·8	19 45 34·0	21
24	8 29 24·0	36 43 3·8	19 55 4·1	5
26	8 36 46·2	37 25 3·6	20 13 37·0	14
27	8 4 33·7	37 45 48·0	20 22 38·2	14
Mar. 2	7 54 25·6	38 50 44·9	+20 50 35·8	13

Corrected for refraction, but not for parallax.

Apparent Places of the Stars of Comparison from Lalande, Bessel, &c.

	Appar. R.A. h m s	*Appar.* Decl. ° ′ ″		*Appar.* R.A. h m s	*Appar.* Decl. ° ′ ″
Feb. 6	2 7 11·70	+17 13 11·4	Feb. 26	2 29 9·09	+19 55 24·5
21	2 22 16·60	19 11 20·7	27	2 29 9·19	20 30 25·4
23	25 6·12	19 46 37·2		32 4·25	32 34·5
24	24 48·83	19 47 40·8		32 12·27	34 39·5
26	2 28 18·79	+20 2 48·1	Mar. 2	2 36 19·17	+20 58 46·4

Elements. By M. George Rümker.

	° ′ ″	
M	= 299 13 1·67	Jan. 0·0, 1851, G.M. Time
π	118 48 7·17	Mean Equinox, Jan. 0, 1851
☊	43 17 3·51	
I	16 33 2·13	
φ	4 57 13·50	
Log *a*	0·4114765	
Log *μ*	2·9327918	

These elements are computed from the Altona observation of Nov. 13, and the Hamburgh observations of Dec. 31 and March 2.

They represent the middle observation, thus,

Calculation—Observation $= -0''\cdot10$ in Longitude

— — $= -0''\cdot03$ in Latitude.

METIS.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1851.	Greenwich M.T.	R.A.	N.P.D.	Compd—Obsd. R.A.	Compd—Obsd. N.P.D.	Star of Comp.
	h m s	h m s	° ′ ″	s	″	
Feb. 16	9 15 16·1	9 28 24·81	65 9 17·3	−3·32	+6·2	ε Leonis.
—	9 35 12·0	23·92	14·7	−3·26	+5·3	—
—	9 55 8·8	23·04	10·9	−3·21	+5·5	—

The parallax and computed places were deduced from the ephemeris published by Lieut. Stratford, R.N.

The following assumed *mean* place of the star of comparison for 1851·0 is derived from the *Greenwich Observations* for 1848:—

	R.A.	N.P.D.
	h m s	° ′ ″
ε Leonis	9 37 23·02	65 32 32·68

HAMBURG. Equator. and Mer. Circle. (M. C. Rümker.)

1851.	Hamburg M.T.	Observed R.A.	Observed Decl.	No. Obs.	
	h m s	° ′ ″	° ′ ″		
Feb. 7	8 30 34·7	144 27 3·5	+24 3 54·7	16	Equatoreal.
9	7 32 13·4	143 56 10·3	15 17·7	12	—
10	8 6 11·2	40 7·8	20 52·8	17	—
11	6 57 34·0	143 25 16·1	26 4·6	8	—
13	7 21 50·3	142 53 50·5	36 18·3	8	—
14	7 19 57·2	142 38 28·7	41 4·7	11	—
17	7 20 42·4	141 52 51·5	24 54 29·5	8	—
21	9 16 18·3	140 53 54·7	25 9 25·0	7	—
23	9 11 5·6	26 29·5	15 21·5	11	—
24	9 17 45·7	140 13 13·0	18 3·3	12	—
26	10 54 29·6	139 46 52·6	22 57·0		Mer. Circle.
27	49 45·4	34 47·1	24 54·1		— —
Mar. 2	10 35 41·8	139 0 42·2	29 35·9		— —
10	9 59 27·4	137 48 42·7	32 24·9		— —
19	21 8·2	137 4 35·6	20 40·4		— —
22	9 8 57·1	136 58 43·8	25 13 37·0		— —
30	8 37 51·5	137 4 9·9	24 48 14·2		— —
31	34 6·4	6 54·2	43 35·9		— —
April 3	23 3·7	18 9·2	32 19·2		— —
7	8 8 43·5	137 39 2·6	+24 14 34·0		— —

Corrected for refraction, but not for parallax.

Mean Places, Jan. 0, 1851, of Stars Compared.

R.A.	Decl.	R.A.	Decl.
h m s	° ′ ″	h m s	° ′ ″
9 15 37·45	+25 5 25·3	9 22 55·48	+25 4 1·8
9 21 30·31	+25 19 45·8	9 22 2·52	+25 3 46·3

Deduced from Hamburg Meridian Observations.

MARKREE. Mer. Circle. (E. J. Cooper, Esq., and A. Graham.)

Green. M.T.	R.A.	Decl.	No. Wires.	Obsd—Calcd R.A.	Obsd—Calcd Decl.
1850. d	h m s	° ′ ″		s	″
Dec. 11·706193	9 58 22·72	+18 55 15·0	5	−0·03	0·0
1851.					
Jan. 8·640815	10 1 15·34	20 43 24·1	5	+0·06	0·0
17·613244	9 56 31·84	21 42 44·6	1	+0·17	+2·4
24·590220	51 10·86	22 32 10·6	4	+0·06	+3·1
31·566553	44 42·31	23 20 53·2	5	−0·28	+2·0
Feb. 7·542498	37 34·18	24 5 22·2	5	−0·17	+4·3
20·497877	24 23·53	25 6 34·0	5	−0·34	+2·1
21·494362	23 27·72	9 48·4	3	−0·06	−1·2
22·491131	22 32·24	12 55·1	5	−0·54	+0·8
26·477815	19 4·78	23 1·7	5	−0·33	+0·7
Mar. 1·467965	16 44·12	28 17·5	4	−0·12	+0·7
3·461547	15 18·17	30 43·1	5	−0·16	+1·8
6·452018	13 22·16	32 43·3	5	−0·29	+2·6
7·448885	12 47·39	32 55·1	5	−0·07	−0·2
10·439613	11 13·62	32 27·8	5	−0·16	+2·9
12·433542	10 20·77	31 6·7	5	−0·18	+1·5
18·415875	8 29·58	22 39·4	5	−0·09	+0·9
20·410167	8 8·09	25 18 28·1	5	−0·28	+2·0
29·385594	8 8·12	24 51 50·8	5	−0·25	+1·3
April 2·375025	8 57·00	36 23·9	2	−0·14	+3·2
8·360307	9 11 2·95	+24 9 22·7	5	−0·05	−2·4

Correction for parallax and compared places computed from Graham's elements, *Monthly Notices*, vol. xi. p. 36.

Jan. 8. *Metis* much brighter than was expected.
17. Clouds.
Feb. 21. Extremely faint. Cloudy at last three wires.
March 1. Clouded at fourth wire.
6. Unsatisfactory.
7. Very faint.
10. Bad illumination.
April 2. Transits very uncertain. Bisection not good.

Extract of a Letter from Professor Chevallier.

"I have lately had a clock constructed to mark right ascension in arc; the pendulum vibrating once in $\frac{2}{3}$ of a second of time, or while an arc of 10″ passes the meridian. The clock indicates at the same time sidereal *time* to the nearest minute.

"I have since heard that Sir G. Shuckburgh had a clock on this principle, which is at Greenwich; so I suppose there is no use in describing what has been already done.

"I think the quickness of beat an advantage in observing, but that is a *personal matter.*"

Henderson in vol. xii. of our *Memoirs*, and the results are contained in three tables.

In Table I. we have the instrumental readings for each star observed by reflexion and directly, with the corresponding readings of the barometer and thermometers.

In Table II. each double altitude is corrected for refraction and reduced to its *mean* value for January 1 of the year of observation, and also for January 1, 1849.

Table III. contains the coefficients of parallax and of the correction to be applied to the assumed constant of aberration, as well as of the annual proper motion of each star to reduce the place to January 1, 1849. The excess of the *observed mean* altitude for 1849 above an *assumed mean* altitude is also given, and thus an equation of condition is formed for every observation of each star. We have thus six sets of equations for the two stars, each of which is solved by the method of least squares.

As a final result Mr. Maclear finds that

the parallax of α Centauri =	$0''.9187$	probable error = $0''.034$
the constant of aberration =	$20''.53$	probable error = 0.038

The former investigation in vol. xii. of the *Memoirs* gave $0''.9128$ for the value of the parallax of α *Centauri*, and $20''.52$ for the constant of aberration.

Mr. Maclear adds that his valued first assistant, Mr. Mann, has commenced a fresh series of observations of this remarkable star with the mural circle, and that he is himself attacking the parallax in right ascension with the $8\frac{1}{2}$-foot equatoreal. At the Cape and at Madras, observations for determining the orbit are making very diligently and with powerful equatoreals.

Observations of Zodiacal Light in 1851. By Mr. Lowe, Highfield House, near Nottingham.

January $22^d\ 6^h\ 30^m$.

Apparent, but confused.

January $23^d\ 7^h$.

Tolerably brilliant by fits, situated between α and β *Pegasi*; the edges too confused to enable them to be accurately marked.

January $27^d\ 7^h$.

Brilliant by fits, the upper edge to the west of *Saturn*; the north edge passed near α *Pegasi*.

March $20^d\ 8^h$.

Stars bright. The zodiacal light is better defined on its edges than it had been noticed here this year.

Extent of base on horizon, $23^\circ\ 30'$. Its southern edge cut the horizon $1^\circ\ 30'$ S. of W., and its northern edge 22° N. of W.

	°	′
Mean Long. of Apex	49	30
Maximum Long. of Apex......	51	0
Minimum Long. of Apex......	48	0

Axis, $0^\circ\ 15'$ N. of Pleiades, and the horizon $10^\circ\ 15'$ N. of W.

The north edge was brightest; it passed midway between β and γ *Arietis* (when at rest) and extended to τ *Arietis.* Its southern edge cut the star μ *Ceti.*

The phenomenon of pulsations of greater and less brilliancy was very apparent and was thought to be in periods of 30^s; when at its minimum brightness, the outline was scarcely distinguishable.

At three different periods during the observations the light widened in extent; and this widening took place each time when the light was at its maximum brightness. This was first noticed at $7^h\ 55^m$, when the north edge extended to β *Arietis.* Again, at $7^h\ 59^m$, when the north edge extended midway between β and α *Arietis*, and thirdly, at $8^h\ 3^m$, when it covered α *Arietis;* it remained in this widened state from 1^s to 3^s, returning each time to its mean place between β and γ *Arietis.* Once, when very dim, the north edge was thought to have receded to γ *Arietis* (viz. at $7^h\ 50^m$). The southern edge was not so narrowly watched, owing to a want of guide stars, so that I cannot speak positively as to whether it receded when the north edge advanced, yet the impression made at the time was, that it did not; and once (at $7^h\ 59^m$) was thought to have widened with the northern edge.

March $22^d\ 8^h$.

Pale and confused; pulsations of brightness.

The weather, especially in February and March, has been very much clouded in the evening, which was unfortunate.

Modifications of the Formulæ for computing the Latitude from extra-meridian Altitudes of the Pole Star. By Mr. John Riddle, F.R.A.S., of the Royal Nautical School, Greenwich Hospital.

"In the preface to the *Nautical Almanac*, p. xi., the following formula is given for finding the latitude from an extra-meridian altitude of *Polaris.*

$$l = a - p \cos h + \tfrac{1}{2} \sin 1'' \ (p \,.\, \sin h)^2 \tan a$$
$$- \tfrac{1}{3} \sin^2 1'' \ (p \,.\, \cos h) \ (p \,.\, \sin h)^2$$

where l = latitude
a = true altitude of star
p = apparent polar distance of star in seconds of arc
h = hour-angle of star = sid. time — R.A. of star.

"I call these corrections c_1, c_2, c_3, and I express the two smaller corrections c_2 and c_3, in *minutes* of arc, and keep p also in minutes in the formulæ for c_2 and c_3.

"Since $c_1 = p \cos h$; $(p \sin h)^2 = p^2 - c_1^{\,2} = (p + c_1)(p - c_1)$; substituting this in the second equation, and reducing to seconds.

$$c_2, \text{ in seconds} = 30 \sin 1' \ (p + c_1)\ (p - c_1) \tan a.$$

"In this *expression* p and c_1 are still expressed in minutes, and

as 30 sin 1′ hardly differs from $\frac{1}{100} - \frac{1}{8}\,100$, this quantity is easily allowed for by dividing $(p + c_1)\,(p - c_1)$ by 100 and deducting one-eighth of the quotient, calling the quantity thus found, q.

$$c_2 \text{ in seconds} = q \tan a.$$

"Three figures in the logs, exclusive of the characteristic, are sufficient.

"Lastly, if, as a matter of curiosity, the value of c_3 is desired,

$$c_3, \text{ in seconds} = 20 \sin 1'\,(p \sin h)^2 \sin 1'\,(p \cos h)$$
$$= \tfrac{2}{3}\, q\, c_1 \sin 1'$$

Or as sin 1′ is nearly ·0003, we may say,

$$c_3 = {\cdot}0002\, q\, c_1,$$

In which q and c_1 may be taken roughly.

Example.

"On August 18th, 1851, in longitude 56° east, at $8^h\ 56^m\ 14^s$ mean time at the place, the altitude of the pole star, corrected for dip and refraction, was found to be 56° 28′ 33″; required the latitude: We have for the computation of the corrections,

$$h = 264^\circ\ 1'$$
$$a = 56\ \ 28$$
$$p = 5355'' = 89'{\cdot}3$$

c_1	c_2	c_3
log p = 3·7288*	p = 89·3	q = 70
log cos h = −9·0183	c_1 = 9·3	c_1 = 9
Sum = −2·7471 = log 558″·6	Sum = 98·6	$q\,c_1$ = 630
c_1 = −9′ 18″·6	Diff. = 80·0	Const. = ·0002
	Prod. × ·01 = 78·88	Prod. = 0·13 = c_3
	−⅛ = 9·86	
	q = 69·02 log = 1·839	
	tan a = 0·179	
	2·018 = log 104″·2	

	° ′ ″
Alt. =	56 28 33
− c_1 =	+ 9 18·6
	56 37 51·6
+ c_2 =	+ 1 44·2
	56 39 35·8
− c_3 =	+ ·1
Latitude =	56 39 35·9 N.
=	56 39 35·5 by spherics.

* Logarithms of 5 places must be used if the result is required to decimals of a second.

***On the Elements of the Binary Star γ Virginis, resulting from a Discussion of the Measures taken by Capt. W. H. Smyth, R.N. between the Years* 1831 *and* 1850.** By Mr. Hind.

"It is well known to the members of the Royal Astronomical Society, that amongst the stars observed for the *Bedford Cycle* by Captain Smyth, the interesting binary system *γ Virginis* occupied a prominent place. During the period included by the Bedford measures, a very critical and important part of the orbit was passed over, and great pains were bestowed upon the observations to render them as accurate as the nature of the object would permit. In 1831 the component stars were separated about $1''\frac{1}{2}$, the smaller one being situated in the north following quadrant about 12° above the parallel of declination. From this position it was watched by Captain Smyth during its passage through the same quadrant, the central distance diminishing each year until in the early part of the year 1836 the star was pronounced *single* under the best atmospheric conditions. Before the close of the spring the Bedford telescope again afforded indications of duplicity, and two nights' observations showed that the companion had just completed a fourth part of its orbit, its position being now 12° north preceding the principal star. In 1837 a further change of no less than 83° in the same direction had taken place, the *comes* lying in the angle 265° at a distance of rather more than half a second of arc from the primary. In 1847 Captain Smyth found it still on the preceding side, but at a central distance of $2''\cdot6$, and his observations early in the year 1848, showed that it had just passed the vertical point, the measures yielding an angle of $179^{\circ}\cdot5$; and at the date of the last observations in 1850, the angle had further diminished to $177^{\circ}\cdot1$. It thus appears that the whole series of measures taken with the Bedford telescope include a change in the *position* of the companion-star of 260°, or nearly three-fourths of a revolution, extending, as before remarked, over a very important part of the orbit. The question, therefore, naturally suggests itself, whether an investigation of the elements from this series of measures to the *exclusion of all others*, might not be one of some value, as showing, by comparison with elements founded upon the *whole of the measures of other astronomers*, including the valuable alignments of Bradley and Pond in 1718 and 1720, what kind of dependence we may place upon elements for other binary systems computed under similar circumstances, where, during the interval between the earliest and latest observations, a portion only of the ellipse has been described, which is to be traced chiefly from the measures of one observer. In the present instance the investigation promised to lead to results of especial interest; the measures of *γ Virginis*, published in the *Bedford Cycle*, were taken by one of the most experienced observers of the present day in this particular department of astronomy, were made throughout with the same instrument, and under the most favourable conditions as regards the state of the *atmosphere*, the powers employed, &c. With data

derived under these promising circumstances, an orbit fairly approximating to the true one (or to that which we have strongest reason to rely upon) might be expected as the result of their discussion; but I confess I had no idea that this series of measures (leaving untouched, as it does, the more distant part of the apparent ellipse when observations are made with comparative facility and proportionally greater accuracy), would produce a set of elements bearing such close resemblance to those of Sir John Herschel, which having been calculated upon the whole course of observations, on a method possessing peculiar recommendations, we may fairly presume to be the most exact system at present in the hands of astronomers. For the sake of immediate comparison the two orbits are subjoined together:

Elements of γ Virginis.

	I. From the Observations of Capt. W. H. Smyth.	II. Sir John Herschel's last Elements.
Perihelion Passage	1836·40	1836·39
Position at Perihelion	323° 50′	322° 12′
Ascending Node	20 34	28 42
Inclination to Plane of Projection	27 23	30 39
Angle between the Lines of Apsides and Nodes upon the Orbit	300 13	290 30
Excentricity	0·8804	0·8860
Period of Revolution	171^{yrs}·54	183^{yrs}·14

Motion in the Orbit — *retrograde.*

"In comparing these orbits, it must be borne in mind that in the present case an alteration in the position of the node of 10° has but very little influence upon the computed angles of position; and for this reason the node and the angle between the lines of nodes and apsides cannot be exactly ascertained. The agreement between the other elements is, I think, very remarkable; and as regards the period, the observations of Capt. Smyth furnish us with the time of revolution of the companion-sun round the other, differing less than *twelve* years from that which, under existing circumstances, may be regarded as the true one."

The Rev. Alfred Weld, director of the observatory at Stonyhurst College, has sent the details of his observations to determine the place of Weisse, 11^h, 929. The individual results are very fairly consistent.

Mean place Jan 1, 1850.

Weisse, 11, 929 R.A. $2^h\ 52^m\ 36^s{\cdot}38$ 6 obs. Dec. $-10°\ 16'\ 20''{\cdot}8$ 5 obs.

In reference to Mr. John Riddle's solution of the problem for clearing the moon's distance (vol. xi. p. 63, &c.), Mr. Drach re-

marks that it does not materially differ from a method given by Lieut. Raper, *Practice of Navigation*, third edition, p. 286, &c., where the traverse table is used for computing the corrections.

Mr. J. W. Jeans, F.R.A.S., of Grantham, suggests that the appearances seen by Mr. Read on the 4th of last September (p. 48) probably arise from some disorder of the digestive organs. Mr. Jeans has himself seen similar appearances while observing *Venus* by daylight, and with the eye fatigued; they vanished when the eye was rested. Something similar has presented itself pretty frequently to other observers, and is generally attributed to a disordered action of the optic nerve arising from indigestion or from over-work.

Mr. Thomas Hedgcock, Master in the Royal Navy, sent a Hadley's quadrant with some modifications, which were described in an accompanying memoir. The Editor is not able to comprehend the proposed improvement, as Mr. Hedgcock has not pointed out with sufficient clearness that defect in the usual construction which he has intended to remedy. A small level is attached to the frame of the sextant to serve when the sea horizon is not distinct, but this is not a novelty.

ERRATA.

Vol. xi. p. 64, 12 lines from the top, *for* altitudes, *read* altitude.
65, 3 lines from the bottom, *for* 0·137, *read* 1·137.
—, last line, *for* 0·720, *read* 1·720.

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ROYAL ASTRONOMICAL SOCIETY.

Vol. XI. April 11, 1851. No. 6.

J. C. Adams, Esq., President, in the chair.

Rev. S. K. Swann, Castle Donnington, Leicestershire; and James Walby, Esq., 13 Westbourne Park Road,

were balloted for and duly elected Fellows of the Society.

METIS.

Liverpool. Equatoreal. (Mr. Hartnup.)

1851.	Greenwich M.T.	R.A.	N.P.D.	Star of Comp.
	h m s	h m s	° ′ ″	
Mar. 20	11 24 34·3	9 8 7·75	64 41 44·0	ι Leonis
	12 4 27·9	7·49	45·7	—
22	11 17 30·1	9 7 54·23	64 46 38·7	—
	11 57 23·9	54·28	42·2	—
April 3	7 54 58·0	9 9 12·92	65 27 40·9	—
	8 34 52·3	13·36	48·1	—
4	7 51 19·5	9 9 31·64	65 31 59·3	—
	8 31 13·7	31·86	68·4	—
7	8 30 30·9	9 10 37·52	65 45 46·8	—
	9 20 25·4	38·54	56·4	—
8	9 16 54·4	9 11 3·64	65 50 43·5	—
	9 56 48·9	4·55	53·9	—
23	11 4 52·9	9 20 24·43	67 15 10·5	—
	11 34 49·1	25·51	16·7	—
25	10 6 42·8	9 21 59·66	67 27 39·5	—
	10 36 39·2	60·81	47·5	—

bservations are corrected for refraction and parallax. The horizontal vas derived from Mr. Graham's ephemeris (*Ast. Nach.* No. 774). llowing is the assumed *mean place* of ι *Leonis* for 1851·0, derived from wich observations, 1848:—

R.A.	N.P.D.
h m s	° ′ ″
9 37 23·02	65 32 32·68

On the Determination of the probable Stability of an Azimuthal Circle by Observations of Stars and of a permanent Collimator. By G. B. Airy, Esq., Astronomer Royal.

"Although the subject of the following investigations is entirely special to the Royal Observatory, and its details will therefore appear with propriety in the *Greenwich Observations*, yet I think it may not be unworthy of the notice of this Society; partly because practical problems of the same kind will occur in the management of many instruments, and partly because the problem of probabilities which occurs in it presents itself in a form which I have not seen before.

"The zero of azimuth of the horizontal circle of the Altazimuth Instrument at the Royal Observatory is determined by observing a star, and comparing the reading of the circle with the computed azimuth of the star, as calculated from the elements of the star's place and the sidereal time corrected from observations with the Transit. It has been found that this zero is unsteady to the amount of a few seconds of arc. This may depend, on the one hand, upon instability of the circle, or, on the other hand, upon the error of sidereal time in the observation (this latter error being compounded of errors in the position of the Transit-instrument, errors in the observation of transit, errors in the transmission of time from one instrument to the other, and errors in the actual observation with the Altazimuth: the elements of the star-places being sensibly perfect). Although this latter combination of causes of error appears formidable, still, from the great care employed to secure accuracy in every part, I thought it likely that their effect was extremely small; and, though in great uncertainty as to the real origin of the discordance, I was inclined to attribute it to unsteadiness of the azimuthal circle.

"In the month of February, 1850, I mounted a permanent Collimator for reference of the telescope of the Altazimuth. The object-glass of the collimator is the 25-feet object-glass of the old zenith tube; the mark is the image (as formed by a lens of short focus, diminishing the diameter to about one-sixth part) of a hole in a plate of metal, behind which is the flame of a gas-lamp. The diameter of the hole is $\frac{1}{50}$ inch, and the diameter of its image, or of the virtual mark, is therefore about $\frac{1}{300}$ inch. This mark is seen so well-defined, that its observation may be regarded as free from sensible error. It may perhaps be regarded as an unfavourable point in the mounting of this apparatus, that the object-glass is fixed in the wall of one building and the mark within another building; but every other circumstance is very favourable.

"As soon as the computation of the year's observations was completed, I collected all the observations of the collimator, and the results of computation of azimuth-zero, from February 11 to *December 27*, in a tabular form, under the heads of Circle-reading

for Observation of the Collimator, Apparent Azimuth of the Collimator from the Observation of Stars on the same day, and Zero of Azimuth of the Horizontal Circle from the observation of the same stars. (It is easily seen that the third quantity is equal to the excess of the first over the second; but the three quantities represent three different though connected elements, upon all which information is desirable.) An examination of these gives reason to suppose that a gradual change has taken place in each, at least in the first and second. There have also been some changes of adjustment in the intervals between lunations. For these reasons it appeared desirable, in an investigation of the comparative values of the irregular errors, not to use the absolute values of the three elements which I have mentioned, but to ascertain the mean values of these elements for each lunation, and to treat as the subjects of discussion the difference of every individual value of each element from the mean of that element for the month.

"The meanings of the different quantities of which I have last spoken can be explained in the following way:—First, we may determine the azimuth of an unknown body (as the moon) without any regard to the constancy of the circle (except for a few minutes), or to the constancy of the collimator, by observation of one or more stars. Let x be the error of azimuth produced by error in the observation of the stars, or in the transmission of time from the transit-instrument. Then the apparent azimuth of the collimator will be increased by x; and since the apparent azimuth of any object is increased by x without any alteration of the circle-reading, the zero of azimuth of the horizontal circle is increased by $-x$. Secondly, we may determine the azimuth of the moon, &c., by assuming the constancy of the circle. If the position of the circle has undergone such a change as to increase deduced azimuths by y, then the circle-reading for observation of the collimator will be increased by y; but when the observations of stars are referred to the circle, the instrumental azimuths of those stars are also increased by y, and therefore the zero of azimuth of the horizontal circle is increased by y. Thirdly, we may determine the azimuth of the moon by assuming the invariability of the collimator, using the circle only as an intermediate between the collimator and the moon, &c. Suppose the collimator to have so shifted that the deduced azimuths are increased by z. Since the circle-reading for the moon, &c., is supposed unaltered, the circle-reading for observation of the collimator must be supposed increased by $-z$; and since the circle-reading for stars is unaltered, the apparent azimuth of the collimator from the observation of stars will be increased by $-z$.

"If, now, we put p for the whole increase of circle-reading for observation of the collimator, q for that of the apparent azimuth of the collimator from the observation of stars, and r for that of the zero of azimuth of the horizontal circle from the observation of the same stars, we shall have, by collecting the quantities above found,

$$\begin{aligned} p &= \quad\; y - z \\ q &= \quad\; x - z \\ r &= -x + y \end{aligned}$$

The quantities p, q, and r are given numerically from the results of observation. Our object now is to determine from these the *probable values*, in a series of observations, of x, y, z, considered as chance errors, and thus to determine which of the three different assumptions used as bases for determination of the moon's azimuth (namely, 1st, that the transmission of time and the observations of stars are correct; 2d, that the circle does not change its position; 3d, that the collimator does not change its position) is most trustworthy. This is all that we can pretend to do; for, as the equations for p, q, r are not independent, it is evident that we cannot find the *absolute* values of x, y, z on any one day. But the following consideration will show that we have sufficient means for determining their *probable* values.

"Suppose it was found, in a long series of observations, that p is generally small: that is, that the errors (whatever they may be) on the second and third assumptions are nearly the same, or, in other words, that the results of the second and third assumptions always agree, that of the first being frequently discordant. Here we should not (in the ordinary familiar treatment of such matters) have the smallest hesitation in saying that we consider the first assumption as much less trustworthy than the others, provided always that we are certain that the errors (whatever they may be) of the second and third assumptions are absolutely independent. Reasoning of a similar character might be used in obtaining results on other suppositions on the relative values of p, q, r. Thus it appears that the data of the problem are sufficient to give us, in ordinary careful reasoning, a clear insight into the relative amounts of errors of the different assumptions; and the theory of probabilities is but an exhibition of such ordinary careful reasoning in a form which admits of numerical calculation.

"To put the investigation into a more technical shape, we must first remark that, so far as can be judged from the independence of the pier carrying the azimuthal circle, the two walls carrying the collimator, and the two pillars carrying the transit-instrument, the three chance errors x, y, z, are absolutely independent. Secondly, that if we put X, Y, Z, P, Q, R, for the probable values of x y, z, p, q, r, and a for a certain constant factor, we shall have $X^2 = a \,.\, \Sigma x^2$, &c.; $P^2 = a \,.\, \Sigma \,.\, p^2$, &c.; and since, by a well-known theorem of probabilities, $P^2 = Y^2 + Z^2$, it follows that

$$\Sigma \,.\, p^2 = \Sigma \,.\, y^2 + \Sigma \,.\, z^2$$

and similarly,

$$\Sigma \,.\, q^2 = \Sigma \,.\, x^2 + \Sigma \,.\, z^2$$
$$\Sigma \,.\, r^2 = \Sigma \,.\, x^2 + \Sigma \,.\, y^2$$

"These equations, however, may be proved without refer-

ence to the theory of probabilities in the following manner:— $\Sigma . p^2 = \Sigma . y^2 - 2 \Sigma . y z + \Sigma . z^2$; but as y and z are strictly independent, in a long series of observations any given value of y may be supposed to be multiplied by equal positive and negative values of z, and therefore $\Sigma . y z = 0$. Thus there remains $\Sigma . p^2 = \Sigma . y^2 + \Sigma . z^2$; and similarly for the others. Having these three equations, we find $\Sigma . x^2$, $\Sigma . y^2$, and $\Sigma . z^2$, without difficulty; and thence X, Y, and Z.* I shall now proceed with the numerical elements :—

"*Mean Values, for each Lunation, of the Elements of Position for the Azimuth Circle and Collimator of the Altazimuth, from* 1850, *Feb.* 18, *to the end of the Year.*

Limits of Lunations. 1850.					Circle Reading for Observation of Collimator. ° ′ ″	Apparent Azimuth of Collimator from Star Observations. ° ′ ″	Apparent Zero of Azimuth of Horizontal Circle from Star Observations. ° ′ ″
Feb.	18	to	March	6	190 22 21·50	179 37 59·29	10 44 21·74
March	15	—	April	4	23·08	63·97	19·11
April	17	—	May	4	25·63	64·67	20·96
May	13	—	June	3	26·69	68·59	18·10
June	13	—	July	5	34·72	78·27	16·45
July	14	—	Aug.	4	34·86	78·52	16·34
Aug.	12	—	Sept.	2	36·25	82·21	14·04
Sept.	10	—	Oct.	1	36·54	71·50	25·05
Oct.	8	—	Oct.	29	33·03	70·70	22·33
Nov.	6	—	Nov.	25	30·07	68·40	21·67
Dec.	7	—	Dec.	27	190 22 29·75	179 37 62·12	10 44 21·63

"It would appear that the collimator was disturbed between June 3 and June 13, but no intentional change in its position was made. Between September 2 and September 10 there is a considerable change of the second and third elements, evidently depending on star observations or their reductions; this is, undoubtedly, due to uncertainty on the adjustments of the transit instrument: the line of collimation of the transit was found, at the end of the year, to have changed considerably; and, after careful examination of the transits, it was concluded that the change took place *suddenly* between September 4 and September 6, and the azimuthal errors of the transit and the clock errors were investigated on that supposition; but if the change were really *gradual* (as now appears probable), that assumption of sudden error would produce an apparently sudden change in the elements of the altazimuth depending immediately on the observations of stars.

* "It is, perhaps, proper to mention, that in a paper communicated to the Society in the summer of 1850 (but subsequently withdrawn), I had treated this problem by a much more complicated process, of the correctness of which, however, I had great doubts. Upon further consideration I arrived at the simple process in the *text*, of the correctness of which I have no doubt."

"*Excess of each Individual Value above the Mean-Lunation-Value of the Elements of Position for the Azimuth Circle and Collimator of the Altazimuth, on every Day on which Stars were observed with the Altazimuth, from* 1850, *Feb.* 18, *to the end of the Year.*

1850.	Circle Reading for Collimator. p. ″	Azimuth of Collimator from Stars. q. ″	Zero of Hor. Circle from Stars. r. ″
Feb. 18	+1·82	+5·53	−3·71
19	+2·29	+3·83	−1·54
20	+1·04	−0·90	+1·94
21	+1·20	+1·95	−0·75
22	−0·25	−5·82	+5·57
23	−1·57	−4·74	+3·17
26	−0·51	+0·33	−0·84
27	−0·97	−1·05	+0·08
March 3	−0·87	−1·43	+0·56
4	−1·92	+1·34	−3·26
5	−0·35	+0·38	−0·73
6	+0·06	+0·53	−0·47
15	−3·47	−5·12	+1·65
16	−0·13	+0·15	−0·28
17	−3·26	−6·47	+3·21
18	−0·75	−6·12	+5·37
21	−1·21	−0·03	−1·18
23	+0·55	+2·38	−1·83
25	+0·59	+3·30	−2·71
26	+1·00	+0·30	+0·70
27	+0·60	+1·32	−0·72
28	+2·03	+5·19	−3·16
29	+2·94	+3·42	−0·48
30	+1·35	+3·92	−2·57
31	+0·23	+0·24	−0·01
April 4	−0·44	−2·41	+1·97
17	+0·38	+2·20	−1·82
18	−0·06	+0·51	−0·57
20	−0·05	−1·75	+1·70
22	−0·22	+1·48	−1·70
23	−0·07	−1·00	+0·93
24	+2·37	−2·69	+5·06
25	−0·13	−2·38	+2·25
26	−0·43	−3·64	+3·21

1850.	Circle Reading for Collimator. p. ″	Azimuth of Collimator from Stars. q. ″	Zero of Hor. Circle from Stars. r. ″
April 27	−1·88	−1·01	−0·87
May 1	−2·22	+2·42	−4·64
2	+1·34	+2·21	−0·87
4	+1·02	+3·64	−2·62
13	+0·60	−0·54	+1·14
18	+1·16	+0·42	+0·74
20	+0·43	−3·17	+3·60
21	+1·26	−3·63	+4·89
22	+0·31	+0·12	+0·19
23	−0·21	−1·57	+1·36
24	+0·01	−1·81	+1·82
27	+0·76	−1·03	+1·79
28	+0·25	−6·15	+6·40
29	−0·24	−3·07	+2·83
30	−1·70	+0·83	−2·53
31	+0·43	+3·89	−3·46
June 1	−1·87	+3·84	−5·71
2	−0·59	+7·58	−8·17
3	−0·68	+4·26	−4·94
13	−0·96	−4·79	+3·83
15	−2·26	−0·27	−1·99
17	+1·01	+2·80	−1·79
18	+0·83	+2·77	−1·94
19	−0·43	−2·73	+2·30
20	+1·57	−5·23	+6·80
21	−1·37	−1·49	+0·12
22	−0·50	−0·58	+0·08
23	−1·65	−2·42	+0·77
24	−0·29	−1·46	+1·17
25	−1·86	−2·48	+0·62
29	−0·24	+6·43	−6·67
July 1	+2·21	+1·60	+0·61
2	+1·72	+1·32	+0·40
4	+1·56	+6·95	−5·39

1850.		Circle Reading for Collimator. p. ″	Azimuth of Collimator from Stars. q. ″	Zero of Hor. Circle from Stars. r. ″
ly	5	+0·60	−0·46	+1·06
	14	−0·70	−3·47	+2·77
	15	+1·24	−4·41	+5·65
	16	+0·55	−1·18	+1·73
	21	+0·64	−3·39	+4·03
	22	+0·64	+2·01	−1·37
	24	−0·39	−1·22	+0·83
	25	+0·47	+3·56	−3·09
	27	−0·28	−0·97	+0·69
	29	+0·19	+2·27	−2·08
	30	−0·45	+1·10	−1·55
ug.	4	−1·91	+5·67	−7·58
	12	+0·40	+1·42	−1·02
	13	+0·39	−3·10	+3·49
	14	−0·55	−2·58	+2·03
	15	−0·35	−2·55	+2·20
	17	−1·01	+4·37	−5·38
	19	+0·91	−5·64	+6·55
	21	−1·64	+6·51	−8·15
	22	+1·20	+3·55	−2·35
	23	+2·21	+4·70	−2·49
	24	+1·21	+3·99	−2·78
	26	−1·02	−1·81	+0·79
	29	−0·55	−3·80	+3·25
ept.	2	−1·17	−5·04	+3·87
	10	+0·27	+0·98	−0·71
	11	+1·11	+3·09	−1·98
	12	+3·22	+5·73	−2·51
	13	+1·16	−0·72	+1·88
	14	+0·47	+0·96	−0·49
	18	+0·94	−0·71	+1·65
	21	−0·37	+2·37	−2·74

1850.		Circle Reading for Collimator. p. ″	Azimuth of Collimator from Stars. q. ″	Zero of Hor. Circle from Stars. r. ″
Sept.	25	−1·21	−1·40	+0·19
	28	−2·08	−4·25	+2·17
Oct.	1	−3·52	−6·02	+2·50
	8	+0·69	+2·39	−1·70
	11	+0·43	−1·75	+2·18
	12	+0·53	−1·29	+1·82
	15	−0·25	−0·30	+0·05
	16	+1·93	+1·63	+0·30
	17	−0·04	+0·36	−0·40
	18	−0·66	−0·69	+0·03
	21	−1·39	+4·76	−6·15
	26	−0·88	−7·76	+6·88
	28	−0·58	−0·45	−0·13
	29	+0·25	+3·09	−2·84
Nov.	6	−0·12	−3·30	+3·18
	7	−0·41	−2·10	+1·69
	8	−0·05	+1·07	−1·12
	11	−0·20	+2·25	−2·45
	12	−0·44	−2·27	+1·83
	14	−0·28	+4·63	−4·91
	16	+0·74	−1·43	+2·17
	19	+0·75	−2·99	+3·74
	23	+1·09	+0·12	+0·97
	25	−1·03	+4·05	−5·08
Dec.	7	−0·83	+0·51	−1·34
	12	+3·22	+4·23	−1·01
	14	+1·93	+2·81	−0·88
	17	−1·93	+0·70	−2·63
	19	−0·87	+2·69	−3·56
	20	−2·17	−6·35	+4·18
	21	+0·64	−0·28	+0·92
	27	−0·02	−4·35	+4·33

" If we square each of these numbers and form the sums of the quares for each column, they are found to be 211·55, 1422·07, nd 1258·88. Thus we have the equations,

$$\Sigma \,.\, y^2 + \Sigma \,.\, z^2 = 211{\cdot}55$$
$$\Sigma \,.\, x^2 + \Sigma \,.\, z^2 = 1422{\cdot}07$$
$$\Sigma \,.\, x^2 + \Sigma \,.\, y^2 = 1258{\cdot}88$$

" By solution of these,

$$\Sigma \, . \, x^2 = 1234{\cdot}70$$
$$\Sigma \, . \, y^2 = 24{\cdot}18$$
$$\Sigma \, . \, z^2 = 187{\cdot}37$$

and, remarking that the number of observations is 132, we find for the probable error of each,

$$X = \pm 2''{\cdot}07$$
$$Y = \pm 0{\cdot}29$$
$$Z = \pm 0{\cdot}80$$

" Thus it appears that the chance-error in the assumption of the invariability of the horizontal circle is little more than one-third of that in the assumption of the invariability of the collimator, and one-seventh of that depending upon the star-observations or on the transmission of time from the transit-instrument. And if we use, in combination, all the different assumptions for determining the azimuth of the moon or any unknown object, we shall have to give them weights nearly in the proportion of 50, 7, and 1.

" As the small quantity $\Sigma \, . \, y^2$ is found by the expression,

$$\tfrac{1}{2} (\Sigma \, . \, p^2 + \Sigma \, . \, r^2 - \Sigma \, . \, q^2),$$

it is obvious that a small error in either of the large numbers $\Sigma \, . \, q^2$, and $\Sigma \, . \, r^2$, will produce a disproportionately large effect in the ratio which $\Sigma \, . \, y^2$ bears to $\Sigma \, . \, x^2$ and $\Sigma \, . \, z^2$. But it will not tend to remove the evidence of the strongly-marked superiority of the assumption of the steadiness of the circle above the other assumptions.

" It is also to be remarked, that the quantities which we have made the subject of discussion are not the discordances from certain fixed values, but the differences between the individual values and the mean of a certain number (generally about 12) of these same individual values. The probable errors X, Y, Z, must, for this reason, be slightly increased; but they will be all increased in the same proportion.

" The rule which is now adopted at the Royal Observatory for the reduction of the azimuth observations is, to assume the constancy of the circle through each lunation, determining its zero-point from the mean of all the results of star-observations during that lunation. It is considered that in this manner places of the moon, &c., perfectly correct (within very close limits), and strictly corresponding as regards azimuth and zenith-distance, are obtained. In the comparison of the observed places with tabular places, the comparison of both elements will be affected by the chance-error in the time-determination of that day. But upon proceeding from the stage of azimuths and zenith-distances to that of hour-angles and polar distances, the effect of this chance-error

in time will be confined absolutely to the hour-angles, and thus the injurious effects will be very much simplified, and may perhaps be effaced by further operations."

On the Measurements of Azimuths on a Spheroid.
By Lieut. A. R. Clarke, R.E.

The author commences his paper with the following words:—

"It is generally assumed in geodetical calculations, that the sum of the reciprocal azimuths of two stations on a spheroid is the same as if the stations were on a sphere and had the same latitudes and difference of longitude. This is based on Dalby's geometrical proof, that the difference between the two sums in question is very small if the stations be equally elevated above the surface. It is not, however (nor can be geometrically), shown that this difference is not greater than the probable error of observation, and therefore it may be useful to find an expression for this small difference in terms of the latitudes and longitudes of the stations, in order to see whether it may be in any case greater than the probable errors of observation, and large enough to be worth taking into account."

The author then investigates by accurate formulæ of analytical geometry, as applied to the co-ordinates of points which satisfy the spheroidal equation, the expressions for the tangents of the angles of reciprocal azimuths of two stations, and forms the accurate expression for the tangent of the sum of azimuths, and for the tangent of the excess of this sum above the sum of corresponding spherical azimuths. The expression is then cautiously reduced, and it is found, at length, that the value of this excess is insensibly small; amounting only to $0''\cdot000003 \times m^2 n$, where m is the number of degrees in the distances of the stations, and n the number of degrees in the difference of latitude. Then the influence of difference of heights is computed; and it is shown that, though (in cases which may arise in practice) it is greater than what has just been found, yet that it also will be insensible.

At the close of the meeting, Mr. De Morgan made some remarks upon the Gregorian Calendar, as an instrument for determining the moon's phases with sufficient accuracy to settle the question of *moonlight*. Having been led to examine it in this point of view, for the purposes of a collection of almanacs which he is preparing for publication (and which has since been published) he found that it may be made to give the day of new moon or of full moon right in three cases out of five, and with an error of only one day in almost all the other cases; the error of two days occurring only about once in 120 results. In order to obtain this amount of accuracy, the rule is:—Use the Gregorian epact to

determine full moons, and that epact increased by 1 to determine new moons; both with the well-known epact-table which appears in all extensive works or articles on the calendar.

The reason of this rule is as follows:—Clavius constructed the Gregorian Calendar expressly in such manner that the moon of his calendar should be always, as well as it could be managed, one day younger than the moon of the heavens; the object being, that the fourteenth day, by which Easter is determined, should follow the day on which the Jews keep the Passover. And as this was done with good success, it follows that one day added to the age of the calendar moon at the beginning of the year, (that is, to the Gregorian epact), gives the same degree of success to the calendar, as a means of determining the day of astronomical new moon.

If the chronological full moon had been correctly laid down, this same addition of 1 would have been equally successful as to the full moon. But the *chronological* full moon is on the *fifteenth* day of the moon. Now, half a lunation being, on the average, $14\frac{3}{4}$ days, it follows that, unless the mean new moon happen in the first quarter of its day, the mean full moon is on the *sixteenth* day; so that, in the long run, the sixteenth is the proper day three times out of four. Hence there is no occasion to increase the epact by 1, in order to determine the astronomical full moon; which is as correctly determined as the calendar will do it, by applying the existing epact to the existing hypothesis of the fifteenth day.

The preceding conclusions as to the probability of truth and error were obtained from the nineteen years 1828–1846; the following are the results for 1851, 1852, and 1853:—

New Moon.

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1851	2	1	2+	1,30+	30	28+	28	26	25	24	23	22
1852	21	19+	21−	19	19	17	17	15	14−	13	12−	11
1853	10−	8	10−	8	8	6	6	4+	3	2	1,30	30

Full Moon.

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1851	17	16	17	16−	15	14−	13	12−	10	10	8	8
1852	6+	5	6	5−	4−	3−	2−	1−30−	29−	28−	27−	26
1853	25	23	25	23	23−	21	21−	19−	18−	17	16−	15

Here are exhibited the days of new and full moon by the calendar: when + or — follows the date, the real day is the day after or the day before. And though in this period of three years the errors of the full moon much exceed in number those of the new moon, there is no such excess in the long run. The nineteen years 1828–1846 gave 140 cases of new moon true to the day, and 141 cases of full moon.

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ROYAL ASTRONOMICAL SOCIETY.

VOL. XI. *May* 9, 1851. No. 7.

Capt. W. H. SMYTH, R.N., Vice-President, in the chair.

The nineteenth volume of the *Memoirs* is now ready for delivery. The price is 6*s.* to Fellows of the Society, and 12*s.* to the Public. Vol. X. of the *Monthly Notices*, which contains the Observations, shorter and less abstruse Memoirs, Abstracts, Lectures, &c., is *given* to purchasers of the 4to. volume.

The two publications are supplementary to each other, and are to be considered as parts of the same series. They contain scarcely anything in common, except the Annual Report, and between them include a complete account of the proceedings of the Society during the year. The low price of this volume is due to the liberality of the Board of Admiralty, who have paid the expense of computing and printing "Fallows' Observations." The Astronomer Royal has given the necessary instructions for performing this work, and discharged the duties of Editor.

"*Memoirs, Astronomical and Geodesical*, by Mr. Maclear, Her Majesty's Astronomer at the Cape of Good Hope," forming part of the 4to. volume, No. XX., have been printed, and are ready for distribution. These memoirs have been printed principally at the expense of the Board of Admiralty. Gentlemen who wish to possess them before the publication of the volume should apply to the Council of the Royal Astronomical Society.

IRENE.

Discovery of Irene. By Mr. Hind.

"On May 19th, at $12^h\ 58^m$ mean time, I discovered another small planet near the star numbered 29490 in the reduced catalogue of the *Histoire Céleste*. A star a little north, and following Lalande's, is omitted upon Wölfer's chart (Hora xvi.), and my attention having been thereby directed to this part of the heavens some years since, I knew that an object so bright as the planet could not have escaped notice, and, accordingly, compared it at once with Lalande's star, with the aid of the wire-micrometer. At $16^h\ 39^m$ the new star followed L. 29490 by $8^s{\cdot}3$, and at $16^h\ 52^m$ the difference of right ascension was $7^s{\cdot}7$, quite sufficient to establish motion in one object. At $17^h\ 15^m$ the difference of right ascension was $6^s{\cdot}6$. The planetary nature of the stranger was, therefore, satisfactorily proved from 36^m interval; and a reference

to the ephemerides of the newly-discovered planets, published in the *Nautical Almanac* and *Berliner Jahrbuch*, showed that all of them were differently situated, and that I had been fortunate enough to discover another new planet.

"Sir John Herschel has selected *Irene* for the name of this planet: the symbol to be a dove with olive-branch and star on head.

"At the time of discovery, the brightness of *Irene* was rather over that of a star of the ninth magnitude. Her light is very blue, and she appears to be surrounded with a faint nebulous envelope not perceptible about the stars in her vicinity."

Observations.

South Villa. Equatoreal. (MM. Bishop and Hind.)

1851.	Green. M.T. h m s	R.A. h m s	N.P.D. ° ′ ″
May 19	13 9 36	16 4 9·61	103 23 36·3
21	11 15 39	16 2 14·16	103 26 23·1
23	11 13 48	16 0 13·67	103 29 42·9

Greenwich. Meridian Circle. (Astronomer Royal.)

1851.	Greenwich M.T. h m s	R.A. h m s	N.P.D. ° ′ ″
May 28	11 31 38·3	15 55 15·16	103 39 10·0
29	26 44·2	54 16·87	41 15·2
30	21 51·1	53 19·64	43 23·2
31	16 58·6	52 22·77	45 40·0
June 2	11 7 15·7	50 31·38	50 24·1
4	10 57 36·6	15 48 43·88	103 55 21·1

Not corrected for parallax.

Liverpool. Equatoreal. (Mr. Hartnup.)

1851.	Greenwich M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	Star of Comp.
May 26	11 53 22·1	15 57 11·82	Mer.	103 35 14·1	−9·9624	γ Libræ
	12 33 14·3	10·21	+7·852	19·4	·9614	—
27	10 30 41·0	15 56 16·48	−8·136	103 37 4·2	·9586	—
	11 10 33·6	14·73	−7·830	8·8	·9615	—
	11 48 26·5	13·13	Mer.	13·3	·9626	—
28	10 37 45·1	15 55 17·14	−8·066	103 39 9·0	·9598	—
	11 11 38·9	15·86	−7·756	10·7	·9620	—
	11 45 32·3	14·33	+6·554	13·9	·9627	—
30	10 23 58·8	15 53 22·10	−8·086	103 43 21·5	·9597	—
	10 58 52·2	20·43	−7·807	25·2	·9621	—
	11 33 45·9	18·95	Mer.	27·1	·9629	—
31	10 19 5·5	15 52 25·25	−8·086	103 45 34·5	·9598	—
	10 53 59·1	23·74	−7·806	38·4	·9622	—
	11 28 52·7	22·24	Mer.	41·0	−9·9630	—

The observations are corrected for refraction. The corrections to be applied

for parallax in time and arc are represented by p and q. P is the equatoreal horizontal parallax.

The following is the assumed *mean* place of the star of comparison for 1851·0, derived from the Greenwich 12-year Catalogue:—

	R.A. h m s	N.P.D. ° ′ ″
γ Libræ	15 27 11·83	104 17 19·49

Cambridge. Northumberland Equatoreal. (Professor Challis.)

1851.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	No. of Comps. R.A.	No. of Comps. N.P.D.	Star.
May 21	11 0 5·2	16 2 15·06	−8·076			5		(a)
	12 5 41·8	11·99		103 26 28·5	−9·9580	Mer.		
	12 17 58·3	11·92	+7·354	103 26 28·6	−9·9579	9	9	(a)

The star (*a*) is Bessel (Weisse), xvi. 38, and Weisse's place is adopted. Mr. Breen readily detected the planet by its blue colour.

Durham. Fraunhofer Equatoreal. (Professor Chevallier.)

1851.	Greenwich M.T. h m s	App. R.A. h m s	Log $\frac{p}{P}$	App. N.P.D. ° ′ ″	Log $\frac{q}{P}$	No. of Comps. R.A.	No. of Comps. N.P.D.	Set.
May 22	11 53 0·6	16 1 12·17	−7·373	103 28 11·7	−9·9662	20	4	1
26	8 7·4	15 57 14·92	−7·838	35 12·1	9·9657	14	4	2
31	11 28 43·3	15 52 22·48	+5·...	103 45 39·3	−9·9672	18	6	3

Durham. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1851.	Greenwich M.T. h m s	App. R.A. h m s	Log $\frac{p}{P}$	App. N.P.D. ° ′ ″	Log $\frac{q}{P}$	No. of Comps. R.A.	No. of Comps. N.P.D.	Set.
May 22	10 40 22·7	16 1 15·12	−8·168	103 28 5·0	−9·9620	12	4	1
26	11 0 56·8	15 57 15·07	−7·905	35 12·5	9·9654	21	7	2
28	10 22 22·6	55 18·73	−8·810	39 7·8	9·9633	24	8	3
	11 28 54·9	15·39	−7·207	10·9	9·9669	18	6	4
29	12 4 13·7	54 15·57	+7·730	41 18·6	9·9664	24	8	5
30	11 32 59·6	53 19·65	+5·000	43 25·8	9·9666	6	2	6
31	10 34 52·6	52 24·54	−7·922	45 35·2	9·9659	21	7	7
June 4	10 38 0·9	48 44·33	−7·644	55 16·5	9·9673	24	8	8
	11 11 34·3	43·14	+5·550	20·0	9·9678	15	5	9
5	10 26 11·4	15 47 52·16	−7·751	103 57 52·8	−9·9675	24	8	10

P is the Eq. Hor. Parallax in seconds of arc; p and q the required corrections in seconds of time and arc respectively.

Mean Places of Stars of Comparison.

h	h m s	° ′ ″	Set.
Weisse xv, 1144	15 59 51·85	103 32 2·1	1
— 1118	58 46·01	40 0·3	2, 3
48 Libræ	49 51·08	50 41·7	4 to 8, and 10
Weisse xv, *910*	15 47 53·46	103 57 23·5	9

By one transit the R.A. of Weisse xv, 1118 would seem to be more correctly . . . 45^s·20. The stars used by Professor Chevallier were the same as Mr. Carrington's, on the same nights.

May 26. Sky very hazy.
28. Very favourable.
29. Much vapour. Objects furred and unsteady.
30. Two indifferent comparisons. Clouds interrupted.
June 4. A small star, 10th mag., very near the planet, s. p. Sky more or less foggy on this night also.
5. The planet s.p. of Weisse xv, 910, and very close to it. The result of this set should be good, as all circumstances were particularly favourable.

HAMBURG. (M. C. Rümker.)

1851.	Hamburg M.T. h m s	App. R.A. ° ′ ″	App. Decl. (not Corrected for Parallax.) ° ′ ″	
May 24	10 39 0·7	239 49 12·8	−13 31 36	
	11 51 26·2	48 23·6	30·2	Mer. Circle.
26	10 25 51·3	239 19 24·6	35 2·8	
	11 41 36·0	......	20·3	Mer. Circle.
27	10 16 13·3	239 4 44·1	36 59·8	
	11 36 40·8	3 50·8	75·2	Mer. Circle.
28	10 25 46·4	238 49 26·4	39 4·0	
	11 31 46·5	49 11·4	9·3	Mer. Circle.
30	13 26 42·6	238 19 7·7	43 30·2	
31	10 19 27·2	238 6 42·6	45 29·8	
	11 17 6·6	6 3·5	38·8	Mer. Circle.
June 1	10 16 22·0	237 52 42·2	−13 47 53·3	
	11 12 14·4	51 58·1	54·3	Mer. Circle.

Apparent Places of Compared Stars observed with Mer. Circle.

		R.A. h m s	° ′ ″
May 24	*a*	15 59 53·581	−13 32 3·9
31	*b*	58 46·839	40 1·5
	ψ Lib.	15 49 52·719	−13 50 43·7

Circular Elements.

By Mr. N. Pogson, Junior Assistant at Mr. Bishop's Observatory.

$r = 2·45945$

	° ′		° ′
☊	83 37·71	I	10 42·36
Arg. of Lat. at Epoch	156 18·89		
Daily Motion in Orbit.........	15·695		

Epoch, May 19·54833

Mr. Pogson contributed an Ephemeris, which has been forwarded to several *observatories for* immediate use.

Elliptic Elements. By MM. Vogel and G. Rümker, from Mr. Hind's observation May 19, and the observations made May 24 and May 31.

May 24·0 M.T. at Berlin.

	° ′ ″	
M	42 4 48·98	
ϖ	183 54 29·82	Mean Equinox,
☊	87 58 59·38	Jan. 0·1851.
I	8 34 42·98	
φ	9 46 35·5	
Log *e*	9·2299526	
Log *a*	0·4070989	
Log *μ*	2·9393582	

The calculation agrees with the middle observations in longitude as well as in latitude.

Ephemeris. By MM. Vogel and G. Rümker.

10^h Berlin Mean Time.

	R.A. h m s	N.P.D. ° ′	Log. Δ.
June 1	15 51 31	103 47·8	0·10934
2	50 35	50·2	
3	49 40	52·7	
4	48 47	55·2	
5	47 55	103 57·8	0·11511
6	47 4	104 0·5	
7	46 13	3·3	
8	45 24	6·2	
9	44 36	9·1	0·12202
10	43 50	12·1	
11	43 6	15·2	
12	42 22	18·4	
13	41 40	21·7	0·12998
14	40 59	25·0	
15	40 20	28·5	
16	39 43	32·0	
17	39 7	35·5	0·13889
18	38 32	39·1	
19	38 0	42·9	
20	37 29	46·7	
21	36 59	50·6	0·14863
22	36 32	54·6	
23	36 6	104 58·7	
24	35 42	105 2·8	
25	35 20	6·9	0·15908
26	35 0	11·2	
27	34 41	15·5	
28	34 23	19·9	
29	34 8	24·3	0·17011
30	33 55	28·8	
July 1	33 44	33·4	
2	33 34	38·0	
3	15 33 26	105 42·7	0·18161

ASTRÆA.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1851.	Greenwich M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	Compd.—Obsd. R.A. s	Compd.—Obsd. N.P.D. ″
May 12	9 59 9·1	14 23 30·57	95 0 42·4	+5·29	+24·0
	10 24 4·5	29·74	38·9	5·31	24·3
	10 48 59·9	28·90	35·2	5·33	25·0
	11 13 55·4	28·17	31·8	5·23	25·3
13	10 32 20·2	14 22 42·79	94 57 44·4	5·35	26·5
	10 52 16·4	42·23	41·9	5·27	26·7
	11 12 12·6	41·43	39·9	+5·43	+26·4

The parallax and computed places were deduced from the ephemeris contained in the Supplement to the *Nautical Almanac*, 1854.

The star of comparison for all the observations was *μ Virginis.*

The following is the assumed *mean* place for 1851·0 derived from the Greenwich Observations:—

	R.A. h m s	N.P.D. ° ′ ″
μ Virginis	14 35 12·80	95 0 26·05

METIS.

DURHAM. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

Set.	Date	Green. M.T. h m s	App. R.A. h m s	Exc. of Ephem. s	App. N.P.D. ° ′ ″	Exc. of Ephem. ″	No. of Com. in R.A.	No. of Com. in N.P.D.
1	1850. Dec. 23	15 36 58·2	10 2 50·44	...	70 35 18·9	...	18	6
2	27	14 27 30·6	3 17·25	...	70 19 51·3	...	24	8
3	1851. Jan. 6	13 29 15·9	1 58·08	...	69 29 7·3	...	12	4
4	7	14 38 16·9	10 1 37·80	...	69 22 53·5	...	18	6
5	Feb. 8	10 50 11·1	9 36 37·13	−3·48	65 49 21·8	+6·4	18	8
6		12 28 50·6	32·76	3·42	...	...	meridian	
7	14	13 23 5·1	30 16·16	3·44	65 17 28·4	5·5	24	8
8	16	14 50 39·5	28 10·50	3·03	65 8 15·3	8·6	21	7
9	17	10 45 36·5	27 20·83	3·01	65 4 51·8	5·3	24	8
10	17	11 44 14·8	27 18·68	3·28	65 4 35·4	11·8	meridian	
11	20	13 31 7·6	24 19·70	3·14	64 53 10·3	8·9	24	8
12	21	12 54 37·3	23 25·03	3·34	64 49 57·3	9·2	16	8
13	23	12 47 50·8	21 36·23	−3·26	64 44 7·1	+4·4	11	4
14	Mar. 4	9 11 30·1	14 41·24	...	64 28 30·3	...	14	5
15	10	12 19 29·3	9 11 11·42	...	64 27 38·2	...	24	8

1850, Dec. 27. Wind loud, and sky unsettled.

1851, Jan. 6. Fog prevented further comparisons. γ', the brighter star of *γ Leonis* was used.

Feb. 8. Set 5. R.A. and N.P.D. measures taken separately.
Set 6. Observed with difficulty on the meridian.

Feb. 17. Set 9. Measures very satisfactory, but star indifferent.
Set 10. Meridian. N.P.D. probably indifferent.

Feb. 23. Star in a difficult position. Interrupted by fog.

The above observations are corrected for refraction and parallax, and compared with the ephemeris circulated by Lieutenant Stratford, so far as that *ephemeris extends.*

Mean Places of the Stars of Comparison used at Durham, and of certain other stars near the path of *Metis*, during the opposition of 1850–1, observed on the meridian at Durham: *—

Set.	Name.	Mag.	R.A. (1851·0). h m s	N.P.D. ° ′ ″	No. of Obs.
	(*a*)	8	9 4 53·57	65 5 48·2	1
14, 15	Lalande 18184	6	5 46·60	64 22 27·9	3
	Lalande 18259	9	8 5·83	64 44 40·4	3
	Lalande 18482	8	15 43·66	65 47 4·8	1
	(*b*)	9	16 36·45	64 37 39·6	3
13	(*c*)	8	21 30·35	64 40 15·8	3
11, 12	(*d*)	9	22 55·32	64 55 56·5	2
9	(*e*)	10	28 9·88	65 2 6·4	†
	(*f*)	8	29 2·60	64 56 11·9	3
7, 8	(*g*)	9	29 24·70	65 15 59·4	2
5	B.A.C. 3327	7	36 47·17	65 50 32·8	2
	Lalande 19329	8	44 27·84	66 40 56·1	5
	Lalande 19522	7	51 9·92	67 58 10·0	4
	B.A.C. 3423	7	54 30·00	67 20 1·9	1
4	Lalande 19677	9	9 56 55·60	69 21 50·7	2
2	(*h*)	9	10 0 3·24	70 30 30·5	2
1	B.A.C. 3460	7	0 57·40	70 44 21·4	2
	Lalande 19900	9	6 58·83	70 8 16·8	1
3	γ' Leonis	2	10 11 45·05	69 24 25·4	4

BIELA'S COMET.

Extract of a Letter from Professor Santini of Padua to the Astronomer Royal.

"1851, *April* 3.

"Some time ago, I took the liberty of sending you the elements of the periodic comet of Biela for 1852, in which I had included the effect of the perturbations depending on *Jupiter* and *Saturn*. I have subsequently calculated the alterations depending on the earth and *Venus*; I have not, however, thought it necessary to take notice of those produced by *Mars*, both on account of the smallness of its mass, and because, during the revolution from 1846 to 1852, it is always at a great distance from the comet. The values of the alterations produced by *Jupiter*, *Saturn*, the earth, and *Venus* (ac-

* "Star (*a*) was kindly observed for me at Cambridge by Mr. Breen.

† "The place of Star (*e*) depends on a single comparison with (*f*); it was too faint for the transit. The other stars were observed during February last, and would have been based on more observations had I not been suddenly suspended from work by illness. The corrections to *Nautical Almanac* stars, at present in use at Greenwich, were applied throughout in finding clock-error.

"I should state, in reference to the star-observations, that I find the average error of a single observation of a *Nautical Almanac* star, with the Durham transit-circle, to be in R.A. $\pm$ 0ˢ·05, and in N.P.D. $\pm$ 1″·0, the circle being small. The N.P.D.s are obtained differentially from *Nautical Almanac* stars, the zero of the circle being *too unstable for* independent measures of zenith distance."

cording to my results), will be inserted in an article of the *Astronomische Nachrichten*, which, since the melancholy decease of our veteran colleague Schumacher, are continued by Mr. Petersen; I therefore take the liberty of sending you the elements last obtained, with the addition of the alterations depending on the earth and *Venus*, accompanied with an ephemeris for the search of the comet at its next appearance, which I hope will prove sufficiently exact. I have not thought it advisable to continue it beyond September 30, because it will be necessary to correct the elements after the first observations, and then a new ephemeris founded on the corrected elements may be more convenient.

Elliptic Elements for the Mean Equinox of 28 September, 1852.

Perihelion Passage	$T = 1852$, Sept. 28·68134, Greenwich Mean Time		
Longitude of Perihelion	$\varpi =$	109° 8′ 21″·49	
— of Ascending Node	$\Omega =$	245 52 29·32	
Inclination to the Ecliptic..	$i =$	12 33 16·56	
Angle of Eccentricity	$\varphi =$	49 8 6·36	$\log e = 9·8786679$
Daily Sidereal Motion	$n =$	534″·813993	$\log a = 0·5478692$

"In the calculation of the ephemeris, the following constants have been adopted:—

"1. In the computation of the true anomaly v and radius vector r, by means of the eccentric anomaly E, from the equations

$$\sin \frac{v}{2} . \sqrt{r} = A \sin \frac{E}{2}$$

$$\cos \frac{v}{2} . \sqrt{r} = B \cos \frac{E}{2}$$

I have used $\log A = 0·3962283$, $\log B = 9·9674029$.

"2. For the calculation of the right ascensions and the geocentric declinations referred to the true equinox, the values of the solar co-ordinates referred to the equator are taken from the *Nautical Almanac*, 1852; and the heliocentric co-ordinates of the comet referred to the plane of the equator, measured from the true equinox, are computed by means of the following formulæ:—

$$x = m . r \sin (v + M); \quad y = n . r . \sin (v + N); \quad z = p . r . \sin (v + P);$$

the constants m, n, p, M, N, P, deduced from the elements above, being given by the following table:—

1852.	M. ° ′ ″	Log m.	N. ° ′ ″	Log n.
June 30	198 36 34·7	9·9912824	104 51 57·2	9·9785000
Aug. 29	36 43·7	·9912819	52 5·3	·9784978
Oct. 28	36 49·8	·9912817	52 11·4	·9784961
Dec. 27	198 36 59·6	9·9912813	104 52 20·0	9·9784957

	P. ° ′ ″	Log p.
June 30	139 37 53·8	9·5629343
Aug. 29	38 0·3	·5629502
Oct. 28	38 5·8	·5629585
Dec. 27	139 38 14·3	9·5629684

Ephemeris of the Comet of Biela, referred to the true Equinox.

Greenwich Mean Noon.

1852.	Geocentric R.A. of Comet. ° ′ ″	Difference. ° ′ ″	Geocentric Decl. of Comet. ° ′ ″	Difference. ′ ″	Log. Dist. from the Earth.
June 30	42 27 7.8	+3 24 50.3	+24 16 34.4	+43 36.9	0.29872
July 4	45 51 58.1	3 35 25.6	25 0 11.3	40 30.5	0.28516
8	49 27 23.7	3 46 38.5	25 40 41.8	36 36.9	0.27157
12	53 14 2.2	3 58 22.3	26 17 18.7	31 49.5	0.25797
16	57 12 24.5	4 10 27.4	26 49 8.2	26 0.8	0.24449
20	61 22 51.9	4 22 42.0	27 15 9.0	19 5.2	0.23125
24	65 45 33.9	4 34 54.5	27 34 14.2	10 58.1	0.21832
28	70 20 28.4	4 46 48.1	27 45 12.3	+ 1 37.4	0.20583
Aug. 1	75 7 16.5	4 57 52.2	27 46 49.7	− 8 56.8	0.19593
5	80 5 8.7	5 7 48.2	27 37 52.9	20 39.0	0.18277
9	85 12 56.9	+5 16 9.9	27 17 13.9	−33 20.2	0.17350
13	90 29 6.8		+26 43 53.7		0.16326
Aug. 13	90 29 6.8	+2 40 37.8	+26 43 53.7	−21 39.2	0.16326
15	93 9 44.6	2 41 56.7	26 22 14.5	25 4.1	0.15909
17	95 51 41.3	2 42 59.1	25 57 10.4	28 30.5	0.15523
19	98 34 40.4	2 43 41.4	25 28 39.9	31 57.1	0.15170
21	101 18 21.8	2 44 17.7	24 56 42.8	35 23.4	0.14853
23	104 2 39.5	2 44 25.5	24 21 19.4	38 45.7	0.14572
25	106 47 5.0	2 44 20.7	23 42 33.7	42 3.7	0.14331
27	109 31 25.7	2 44 0.0	23 0 30.0	45 16.1	0.14128
29	112 15 25.7	2 43 25.1	22 15 13.9	48 18.5	0.13965
31	114 58 50.8	2 42 34.8	21 26 55.4	51 13.5	0.13843
Sept. 2	117 41 25.6	2 41 32.3	20 35 41.9	53 56.5	0.13761
4	120 22 57.9	+2 40 16.8	19 41 45.4	−56 28.1	0.13719
6	123 3 14.7		+18 45 17.3		0.13718
Sept. 6	123 3 14.7	+2 38 51.7	+18 45 17.3	−58 46.6	0.13718
8	125 42 6.4	2 37 17.6	17 46 30.7	60 51.2	0.13759
10	128 19 24.0	2 35 34.7	16 45 39.5	62 40.4	0.13836
12	130 54 58.7	2 33 46.2	15 42 59.1	64 15.6	0.13953
14	133 28 44.9	2 31 52.4	14 38 43.5	65 35.2	0.14105
16	136 0 37.3	2 29 53.9	13 33 8.3	66 39.7	0.14292
18	138 30 31.2	2 27 52.4	12 26 28.6	67 29.5	0.14511
20	140 58 23.6	2 25 49.7	11 18 59.1	68 4.4	0.14761
22	143 24 13.3	2 23 46.1	10 10 54.7	68 25.6	0.15042
24	145 47 59.4	2 21 42.1	9 2 29.1	68 33.2	0.15349
26	148 9 41.5	2 19 38.6	7 53 55.9	68 29.2	0.15680
28	150 29 20.1	+2 17 37.8	6 45 26.7	−68 12.5	0.16034
30	152 46 57.9		+ 5 37 14.2		0.16407

FAYE'S COMET.

CAMBRIDGE. Northumberland Equatoreal. (Professor Challis.)

	Green. M.T.	App. R.A.	Log $\frac{p}{P}$	App. N.P.D	Log $\frac{q}{P}$	No. of Comps. R.A.	No. of Comps. N.P.D.	Star of Comp.
1850.	h m s	h m s		° ′ ″				
Dec. 25	7 8 7·5	22 18 9·35	+8·475	95 23 50·8	−9·9154	1	1	(*d*)
1851.								
Jan. 5	6 35 25·0	22 40 52·19	8·450	94 9 1·0	9·9116	6	5	(*e*)
22	6 15 9·7	23 18 31·93	8·467	91 43 48·2	9·9027	1	1	(*f*)
	6 40 50·1	35·56	8·509	32·3	9·9018	8	8	(*g*)
24	6 50 55·0	23 12·86	8·528	91 24 11·8	9·9004	6	5	(*g′*)
27	6 58 34·6	30 13·33	8·543	90 54 50·4	9·8986	8	8	(*h*)
Feb. 6	6 51 16·1	23 54 3·45	8·552	89 10 55·3	9·8935	6	6	(*i*)
26	7 20 33·4	0 44 7·24	8·599	85 26 13·0	−9·8875	2	2	(*k*)
Mar. 4	7 35 25·0	0 59 42·09	+8·609			3		(*l*)

P = the equatoreal horizontal parallax in *arc*, *p* = correction for parallax in R.A. *in time*, *q* = correction for parallax in N.P.D. in *arc*.

Notes.

Dec. 25. Bad observation. Power 240 was tried: on all other occasions power 166 was used.

Jan. 5. Comet extremely faint: observations difficult and uncertain.

22. Comet very faint: an appearance of a nucleus at times.

24. So faint as to be barely visible.

27. Brighter than on any previous occasion, and easily observed. A slight tendency of the coma to the south-following direction.

Feb. 6. Observations excessively difficult, on account of moonlight. The comet appeared at intervals to have a sparkling nucleus.

26. Comet scarcely perceptible: too near the horizon to be observed satisfactorily.

March 4. Of the last degree of faintness on account of the zodiacal light: could scarcely be observed.

Assumed *Apparent* Places of the Stars.

	App. R.A.	App. N.P.D.	Star and Authority for its Place.
	h m s	° ′ ″	
(*d*)	22 22 40·31	95 34 55·9	Bessel (Weisse) xxii, 478
(*e*)	22 41 16·36	94 10 29·5	— — xxii, 870
(*f*)	23 19 28·04	91 38 15·5	— — xxiii, 389
(*g*)	23 21 7·65	91 39 10·2	Lamont's Zones.
(*g′*)	23 21 7·63	91 39 10·4	— —
(*h*)	23 27 28·21	90 38 2·4	Bessel (Weisse) xxiii, 564
(*i*)	23 55 7·47	88 41 51·4	— — xxiii, 1143
(*k*)	0 43 17·05	85 10 16·2	— — 0, 751
(*l*)	0 58 58·73	84 8 4·2	— — 0, 1044

The star (*g*) was observed four times by Dr. Lamont in the Munich zones: the mean result of the four observations has been used. This star, which was not found in any other catalogue, was estimated by Dr. Lamont to be of the 7·8 magnitude, which appeared to be its magnitude when it was compared with the comet.

On the Vibration of a Free Pendulum in an Oval differing little from a Straight Line. By G. B. Airy, Esq. Astronomer Royal.

"In a paper communicated to this Society several years since, and printed in the eleventh volume of their *Memoirs*, I investigated the motion of a pendulum in the case in which it describes an oval differing little from a circle; and I showed that, if the investigation is limited to the first power of ellipticity, and if α is the mean value of the angle made by the pendulum rod with the vertical, then the proportion of the time occupied in passing from one distant apse to the next distant apse, to the mean time of a revolution, is the proportion of 1 to the square root of $4 - 3 \sin^2 \alpha$. When α is small, this proportion is nearly the same as the proportion of $\frac{1}{2}$ to $1 - \frac{3}{8} \sin^2 \alpha$; or the time of moving from one distant apse to another distant apse is equal to the time of half a revolution divided by $1 - \frac{3}{8} \sin^2 \alpha$. This shows that the major axis of the oval is not stationary, but that its line of apses progresses, and that, while the ellipticity is small, the velocity of progress of the apses is sensibly independent of the ellipticity, and may be assigned in finite terms for any value of the mean inclination of the pendulum-rod.

"This theorem, however, fails totally when the minor axis of the oval is small. It is then found that the velocity of progress of the apses is nearly proportional to the minor axis. But, although the movement of the pendulum in this case may be defined to any degree of accuracy by infinite series, it does not appear that it can be expressed in finite terms of any ordinary function of the time. This is to be expected, inasmuch as, when the problem is reduced to its utmost state of simplicity by making the minor axis = 0, the motion of the pendulum can be expressed only by series. The utmost, therefore, for which we can hope is, to determine the general form of the curve and the rate of progress of its apses, on the supposition that the minor axis is small, in series proceeding by powers of the major axis. This might be so extended as to include higher powers of the minor axis, if it were judged desirable.

"I have thought that an exhibition of the first steps of solution (carried so far as to include the principal multiplier of the first power of the minor axis) might be acceptable to this Society, not purely as a mechanical problem, but more particularly because it bears upon every astronomical or cosmical experiment in which the movement of a pendulum is concerned. The difficulty of starting a free pendulum so as to make it vibrate at first in a plane is extremely great; and every experimenter ought to be prepared to judge how much of the apparent torsion of its plane of vibration is really a progression of apses due to its oval motion."

After a careful analysis of the problem, when the pendulum describes an extremely elongated ellipse, the Astronomer Royal arrives at the following conclusion, which is the principal object of his present investigation. If the length of the pendulum be a,

the semi-major axis of the ellipse described by the pendulum-bob be b, and the semi-minor axis be c, then the line of the apses of the ellipse will perform a complete revolution in the time of a complete double vibration (*i.e.* the time of describing the ellipse) multiplied by $\frac{8}{3}\frac{a^2}{bc}$.

"Thus if a pendulum, 52 feet long (which performs its double vibration in 8 seconds), vibrates in an ellipse whose major axis is 52 inches and minor axis 6 inches, the line of apses will perform a complete revolution *from this cause* in 30 hours nearly.

"If a common seconds pendulum (which performs its double vibration in 2 seconds) vibrates in an ellipse whose major axis is 4 inches and minor axis $\frac{1}{13}$ inch, the line of apses will perform a complete revolution *from this cause* in 30 hours nearly.

"The direction of rotation of the line of apses is the same as the direction of revolution in the ellipse.

"It is worthy of remark, that the expression which is thus found for the progression of the apse on the supposition that the minor axis is much smaller than the major, will, if we make in it c very nearly equal to b, correspond exactly to the formula cited in the beginning of this paper, as found by an accurate investigation when the ellipse approaches very near to a circle. It appears, therefore, very probable that, while b is moderately small, the expression for the progression of the apses is true for all values of c up to b.

"Although the principal object of this paper, as mentioned in the beginning, was to point out how far an apparent rotation of the plane of a pendulum's vibration may depend on causes which would exist if the suspension were perfect, and if the point of suspension were unmoved and the direction of gravity invariable, still it may not be uninteresting to point out how an effect, in some respects similar, may be produced by a fault in the suspension. If a pendulum be suspended by a wire passing through a hole in a solid plate of metal, the orifice of that hole may be oval. If the wire be part of a thicker rod tapering to the size of the wire, it may taper unequally on different sides. In either case, there will be two planes of vibration, at right angles to each other, in which, if the pendulum is vibrating, it will continue to vibrate, and in one of which the time of vibration is greater, and in the other less, than in any other plane; and, the amplitude of vibration being very small, the complete motion may be found by compounding the vibrations corresponding to these two planes."

After investigating the effect of these causes of error, the Astronomer Royal arrives at the following conclusion:—"It appears, therefore, that the effect of faulty suspension may be sensibly eliminated between two experiments in which the azimuths of the first vibration differ by 45°; and it may be prudent, in making any important experiment, thus to change the commencement-azimuth in successive trials."

Some Views respecting the Source of Light, &c.

By James Nasmyth, Esq., F.R.A.S.

"Impressed with the conviction that the progress of science has often been most importantly advanced by the setting forth of hypothetical views as to the nature of those causes which result in great phenomena, I am, for these reasons, induced to hazard and venture forth with some views on the subject of the nature of solar light, more especially in reference to the well-known but most remarkable phenomena, occurring in the case of stars of variable and transitory brightness, as also in reference to those wonderful results of geological research, namely, the unquestionable evidence of the existence of an arctic or glacial climate in regions where such cannot now naturally exist; thus giving evidence of the existence of a condition of climate, for the explanation of which we look in vain to any, at present, known cause.

"I must plead the fact of the existence of such wonderful phenomena as these alluded to as my apology for thus attempting to come forth with what, although they may appear crude, theoretical notions, yet may, as tending to direct increased attention to important phenomena, so lead in due time to the developement of truth, and extend the present bounds of our knowledge of those mighty laws which are so mysteriously indicated by the existence of the phenomena in question, and with the evidences of which we are yet surrounded.

"A course of observations on the solar spots, and on the remarkable features which from time to time appear on the sun's surface, which I have examined with considerable assiduity for several years, had in the first place led me to entertain the following conclusion; namely, that whatever be the nature of solar light, its main source appears to result from an action induced on the *exterior surface* of the solar sphere,—a conclusion in which I doubt not all who have attentively pursued observations on the structure of the sun's surface will agree.

"Impressed with the correctness of this conclusion, I was led to consider whether we might not reasonably consider the true source of the latent element of light to reside, *not in the solar orb*, but in space itself; and that the grand function and duty of the sun was to act as an agent for the bringing forth into vivid existence its due portion of the illuminating or luciferous element, which element I suppose to be diffused throughout the boundless regions of space, and which in that case must be perfectly exhaustless.

"Assuming, therefore, that the sun's light is the result of some peculiar action by which it brings forth into *visible* existence the element of light, which I conceive to be latent in, and diffused throughout, space, we have but to imagine the existence of a very probable condition, namely, the *unequal* diffusion of this light-yielding element, to catch a glimpse of a reason why our sun may, in common with his solar brotherhood, in some portions of his vast

stellar orbit, have passed, and may yet have to pass, through regions of space, in which the light-yielding element may either abound or be deficient, and so cause him to beam forth with increased splendour, or fade in brilliancy, just in proportion to the richness or poverty of this supposed light-yielding element as may occur in those regions of space through which our sun, in common with every stellar orb, has passed, is now passing, or is destined to pass, in following up their mighty orbits.

" Once admit that this light-yielding element resides in *space*, and that it is *not* equally diffused, we may then catch a glimpse of the cause of the variable and transitory brightness of stars, and more especially of those which have been known to beam forth with such extraordinary splendour, and have again so mysteriously faded away ; many instances of which abound in historical record.

" Finally, in reference to such a state of change having come over our sun, as indicated by the existence of a glacial period, as is now placed beyond doubt by geological research, it appears to me no very wild stretch of analogy to suppose that in such former periods of the earth's history our sun may have passed through portions of his stellar orbit in which the light-yielding element was deficient, and in which case his brilliancy would have suffered the while, and an arctic climate in consequence spread from the poles towards the equator, and leave the record of such a condition in glacial handwriting on the everlasting walls of our mountain ravines, of which there is such abundant and unquestionable evidence. As before said, it is the existence of such facts as we have in stars of transitory brightness, and the above-named evidence of an arctic climate existing in what are now genial climates, that renders some adequate cause to be looked for. I have accordingly hazarded the preceding remarks as suggestive of a cause, in the hope that the subject may receive that attention which its deep interest entitles it to obtain.

"This view of the source of light, as respects the existence of the luciferous element throughout space, accords with the Mosaic account of creation, in so far as that light is described as having been created in the first instance *before the sun* was called forth."

Note by the Astronomer Royal.

" In an oral address to the Society, on 1849, December 14, an abstract of which is printed in the *Monthly Notices*, vol. x. No. 2, in describing the method of recording transits by the agency of a galvanic current, I ascribed certain steps of the invention to Dr. Locke and Professor Mitchell. I have lately been informed that the invention was also shared by Mr. Bond, Mr. Walker, and perhaps by other persons. I am desirous of explaining to the Society that the history, such as I gave it at that time, was founded upon the printed papers which had then reached me, and upon my correspondence with American friends ; both necessarily im-

perfect sources of information; and that I had no wish to assert the claims of Messrs. Locke and Mitchell further than as they seemed to be implied in those documents, nor to express any opinion on the claims of others, either to the first idea or to the subsequent steps of the invention."

Description of the Apparatus for observing Transits, by means of a Galvanic Current, now used at the Observatory of Cambridge, U.S. By Mr. G. P. Bond.*

The apparatus exhibited to the Society, is the same which has been for some time past in use at the Harvard Observatory, U.S., and is the property of the United States Coast Survey. It consists of an electric break-circuit clock, a galvanic battery of a single Grove's cup, and the spring governor, by which a uniform motion is given to the cylinder carrying the paper.

The electric clock is of the form proposed by Mr. Bond. Though different in its object and construction, the effect produced is the same with that of the clock proposed by Professor Wheatstone, namely, the interruption of the galvanic circuit at intervals of a second. The pallets and the escapement-wheel are insulated, both from the pendulum and from the other wheels. When the battery is in connexion, the circuit is broken by the pallet leaving the tooth of the wheel, and is restored at the instant of the beat of the clock, which is in fact the sound produced by the completion of the contact restoring the circuit: the passage of the current being through the pallet and the escapement-wheel alone. With the exception of the connecting wires, and the insulation of some parts, the clock is like those in common use for astronomical purposes.

Two wires pass from the clock, one direct to the battery, and the other, through the break-circuit-key used by the observer, and through the recording magnet, back to the battery. The length of wire is of course immaterial.

The magnet, with a slight difference in the form of the armature, is the same with those used on Morse's telegraph lines in the United States. The armature carries a glass pen, supplied with ink from a small reservoir. Under this pen the paper revolves on which the records are made. The breaking of the circuit by the clock, every second, is marked by an offset made by the pen, and the breaking of the circuit by the observer, is similarly recorded between the second marks of the clock. The paper is wound upon a cylinder, as suggested by Mr. Saxton of Washington. Unless a motion perfectly uniform is given to the cylinder, the second marks at the end of an hour, instead of being arranged in regular straight lines upon the paper, will change their relative positions, and the record become so confused as to make it a most serious undertaking to read off the observations after they have been taken.

* This is the substance of a lecture delivered by Mr. Bond, in which the whole *modus operandi* was clearly shown.

To give a uniform motion to this cylinder has been the chief obstacle in the way of the application of electro-magnetism to practical astronomy, so that it should be of general utility; for although very rude contrivances will illustrate the process, and even afford accurate results, the time required to interpret the record may be greater than that required to make the observations throughout by the old method, and the liability to errors in the minutes and seconds is increased. A saving in the quantity of recording surface was also requisite.

The apparatus invented at Cambridge for this object is called the spring governor. The train of wheels which communicates the motive power to the cylinder connects with a small fly-wheel. This fly is for supplying momentum, and holds no part in the regulation. Beyond this fly, reckoning from the cylinder, is a half-seconds pendulum, with a dead-beat escapement. The connexion between the escapement-wheel and the fly is through a short spring. The elasticity of this spring allows the motion of the escapement-wheel to be completely arrested at each vibration of the pendulum, while the momentum of the fly, acting for a small fraction of a second only on the spring, keeps up the motion of the cylinder. The machinery is thus completely under the control of the pendulum. No accumulation of irregularity can take place beyond the limits of the bending and unbending of the connecting spring. After this is adjusted to its minimum, the continuous rotary motion will be performed with all the accuracy of the beats of the pendulum for any length of time. It is, in fact, a complete solution of the difficulty of producing exact uniform motion. An advantageous application of the same principle might be made to the clock-work for the equatoreal motion of telescopes.

The cylinder makes a single rotation in a minute. The second marks and the observations succeed each other in a continuous spiral. When a sheet is filled, and it is taken from the cylinder, the second marks and observations appear in parallel columns, as in a table of double entry, the minutes and seconds being the two arguments at the head and side of the sheet.

The observer, with the break-circuit-key in his hand or at his side, at the instant of the transit of a star over the wire of a telescope, touches the key with his finger. The record is made at the same instant on the paper. The operation may be repeated easily, at intervals between the successive transits, of one or two seconds each.

The experience we have now had places beyond doubt the fact that, for convenience and accuracy of individual results, this new mode of observing is in advance of the old. The number of comparisons for differences of right ascension may be increased to an extent which distinguishes it, equally with its superior accuracy, as a real improvement in the science of practical astronomy. The extension of the method to the registration of differences of declination, simultaneously with differences of right ascension, promises *great facility* in taking zones of small stars.

Owing to the difficulty of obtaining precise information respecting scientific matters in America, considerable inaccuracies have crept into the *historical* part of the lecture given by the Astronomer Royal on the American method of observing by the electro-magnetic circuit (*Monthly Notices*, Dec. 1849). The preceding note from the Astronomer Royal will prevent misconception on this point. But, setting aside the claims of individuals in this matter, so far as this is an American discovery, it is only under the auspices of the Department of the Coast Survey of the United States, and with the facilities and means furnished by its present enlightened superintendent, Dr. A. D. Bache, that the application of electro-magnetism to the purposes of geodesy and of astronomy has been successfully accomplished.

Daguerreotypes of the moon were exhibited to the members present, taken by Messrs. Whipple and Jones, of Boston, from the image formed in the focus of the great equatoreal of the Harvard Observatory.

Extract of a Letter from Mr. Lassell.

"I have been very busy, and have brought to a most successful issue my efforts to support my two-foot speculum free from sensible flexure. All has gone on well and come right at once; and the speculum having been once placed in the tube, I have neither reason nor inclination to take it out again. I was pretty sanguine, yet must acknowledge the result has gone beyond my hopes. I announced the details of the plan to the British Association at Edinburgh,* and there is a clear and sufficient description of it in the Report just about publishing, or perhaps already out. I have scarcely varied at all in carrying it out. I have found 27 or 28 levers sufficient; and these are about as many as can be conveniently applied without interfering with the 18 discs and levers for zenithal support. Moreover, I have found cementing fulcral blocks of speculum metal upon the back with plaster of Paris quite efficient —firm enough to bear twice the requisite strain. Each lever, in a horizontal position of the tube, supports 15 lbs. of the speculum's weight; diminishing, of course, as the telescope approaches the zenith, where they are inactive. The superiority of action of the telescope since the application of this apparatus, I think none but myself who have seen it in both states can yet appreciate, and the atmosphere now alone remains my formidable and unconquerable foe, as it is indeed of all large apertures. So tenderly is the metal sustained in all positions, that no part of it can ever come into contact, with more than the pressure of a few pounds, against the tube or box in which it

* *Reports of the Twentieth Meeting of the British Association*, 1850; *Notices and Abstracts*, p. 180, &c. On a method of supporting a large speculum, free from *sensible flexure, by* Mr. Lassell, &c.

is placed. The plan seems to me applicable to specula of two or three times the diameter of mine with equal success. I was scarcely prepared to believe beforehand that the bending would follow so regular a law, as that it should be completely eliminated by a regularly devised system of counteracting support. I believe the application of the apparatus does not add more than 40 lbs. to that end of the tube which contains the speculum.

"Did I mention to you that I had (some time ago now) made an addition and improvement to the polishing machine by communicating a regular slow motion to the polisher? It has given me some trouble and looks complex, but it is efficient, and tends, I think, to greater uniformity of curve. But when I have leisure, I must describe it more fully."

Extract of a Letter from M. Johnson, Esq., Director of the Radcliffe Observatory, Oxford.

"You will be glad to hear that the Radcliffe Trustees have sanctioned the appointment of a second assistant at this observatory. Besides this important addition, the Trustees allow me a journeyman to look after the meteorological department, *i.e.* to prepare the photographic paper, &c., and I am also granted a certain sum for additional computations; altogether, this observatory is now as well set up as it need be.

"My first course will be to direct our attention to completing the catalogue of the northern stars. All our annual catalogues, except 1842, are already brought up to our proposed epoch, 1845; and in a few months all the recognisable stars of Groombridge's catalogue will have been observed. We shall then have to arrange the work, to get out the precessions, and to amend the places of some stars near the pole (not the very close stars), which have been necessarily brought up with slightly inaccurate precessions. In thinking over the form of the catalogue, my present idea is to give every *datum* necessary for the future revision of our places; for though I hope to escape with very few mistakes, I cannot expect to avoid them altogether. This will swell the publication considerably, and the recomputation of all the constants to fit the new places is rather a formidable work. I feel, however, very well disposed to face this; and I trust by a suitable index to supply future observers with the means of verifying any of our places with but little trouble."

Occultation of a Fixed Star by Jupiter.
By the Rev. W. R. Dawes.

1851, May 8, 9^h G.M.T. Having turned my $8\frac{1}{2}$-foot refractor upon *Jupiter*, I instantly perceived a small star near his western edge, and observed its occultation with power 188. The disap-

pearance occurred at $9^h\ 20^m\ 48^s \pm$ G.M.T.; the angle on the limb, measured from the planet's northern pole round by the eastern or following side, being about 250°. *Jupiter* was obscured by clouds at the time of the reappearance of the star, which is Bessel (Weisse) xii, 965. Mean place for 1825, R.A. $12^h\ 54^m\ 49^s{\cdot}21$, $\delta - 4^\circ\ 12'\ 33''{\cdot}2$. It is of the 8th magnitude, according to Bessel.

The air was unfavourable, and the time noted is therefore uncertain to a few seconds.

Micrometrical Measures of γ Virginis. By Isaac Fletcher, F.R.A.S.

"The binary star *γ Virginis*, being an object of extraordinary interest, I beg leave to submit the following measures of its angle of position and distance to the Royal Astronomical Society.

"The measures were taken with extreme care with the six-foot equatoreal and clock motion, and parallel wire-micrometer.

Epoch.	Position.	Weight.	Distance.	Weight.
	° ′		″	
1851·386	176 16	3	3·011	3
·397	175 55	2	3·005	4
·400	175 29	4	3·035	4
·402	176 2	3	3·107	2
·408	176 20	4	3·088	4
·408	175 51	4	3·056	4
Mean 1851·401	175 58	20	3·047	21

"In taking the mean, the several proportional weights are duly allowed for. Each set consists of eight measures of position, and eight double measures of distance."

On the evening of March 12, 1851, as the sun was setting in the midst of a thick haze, Mr. Weld observed a spot on the sun's disc with the naked eye. On pointing it out to one or two other persons, they saw it with facility. Next day he observed the sun with the equatoreal, and found a single large spot nearly round but somewhat angular. Its greatest measured diameter parallel to the equator was $4^s{\cdot}05$, that of the nucleus $1^s{\cdot}60$. Its diameter measured along the meridian circle was $52''{\cdot}53$.

Astronomische Nachrichten.

The Editor of the *Monthly Notices* has received from Mr. J. Schumacher an account of the stock in hand of the lamented Professor's publications, including a complete list of the back Volumes and Numbers of the *Nachrichten*. In the June Notice

he hopes to give a fuller account; but in the mean time he would recommend those gentlemen who possess *incomplete* copies of this invaluable work to send lists of the Volumes and Numbers which they require, and he will try to supply them, without unnecessary cost, on the principle of serving first the first applicant.

ERRATA.

R.A. of Weisse xxi, 937, is 1^m in defect.
Astron. Nachrichten, No. 760, Berlin Observations of *Irene*, *for* May 14 and 16, *read* 24 and 26.

☞ *Owing to the absence of the Editor, and two or three unlucky coincidences, Number 7 went to press in a less correct state than was desirable. A few copies only were taken off and distributed; it has been thought advisable to cancel this first impression and to reprint the whole in the present more perfect form.*

London:—Printed by G. Barclay, Castle St. Leicester Sq.

ROYAL ASTRONOMICAL SOCIETY.

Vol. XI. *June* 13, 1851. No. 8.

Lieut. Henry Raper, R.N., Vice-President, in the chair.

Wm. Francis, Esq., 9 Chadwell Street, Myddleton Square;
Rev. Joshua Sortain, Brighton;
Henry John Doogood, Esq., 13 Fortress Terrace, Kentish Town;
Henry Mugridge, Esq., Nautical School, Greenwich Hospital;
Hugh Neill, Esq., 115 Mount Pleasant, Liverpool;
Richard Dunkin, Esq., 20 Matilda Street, Islington;
Lieut. Andrew St. John, Royal Engineers; and
Rev. W. L. Onslow, H.M.S. Hastings;

were balloted for and duly elected Fellows of the Society.

Astronomische Nachrichten.

Several gentlemen who ordered the *Astronomische Nachrichten* for the current year, on the understanding that it was to be delivered free of postage, have complained that the back numbers have been sent in such a way as to cause a very heavy postage. Dr. Petersen committed the very excusable mistake of thinking that the post-office would deliver the numbers made up into *one* parcel on the same terms as it delivers the *several* numbers. Many deliveries are thus saved, but the authorities reason differently. To obtain the benefit of the recent regulations the *form* must be strictly complied with, and *each* number must be sent with a *separate* direction. The Editor has to apologise in his own name and in that of Dr. Petersen for this mistake, which cannot, however, occur again.*

The Editor would earnestly press on those gentlemen who have imperfect copies of the *Nachrichten* to apply for the missing numbers. The vols. i. and iii. are not to be had entire, and there is only one entire copy of vols. ii., iv., vii. Copies of the volumes

* It is not easy to make out the rules even of our own post-office, and still less those of foreign nations, by any method but that of trial and error, and even then not always satisfactorily. The last Annual Report went quite free to Altona with a penny stamp, but a copy to which a twopenny stamp was attached (the number being a heavy one) cost 2*s.* 6*d.* *though sent to the same address.* The numbers of the *Astronomische Nachrichten* are delivered gratis at Somerset House, but cost a halfpenny at the Athenæum.

antecedent to vol. xii. are very few in number. There is, however, a considerable mass of odd numbers, and it is very desirable that these should find their proper places as far as may be, and as soon.

Comet-Circular received from Dr. Petersen.

"On the night of the 27th of June last, Dr. D'Arrest, of the Leipsic Observatory, discovered a very faint comet in the constellation *Pisces*. The apparent place could only be estimated very approximately on account of the twilight which shortly after ensued.

1851.	Leipsic M.T. h m	R.A. ° ′	Decl. ° ′
June 27	13 10	7 49	+10 32

This may be a few minutes in error.

"Next night was cloudy, and the comet invisible; but the night after proved more favourable, and Dr. D'Arrest obtained two comparisons with Weisse $0^{h}\cdot690$, which he considers as accurate as can be fairly expected considering the extreme faintness of the comet.

1851.	Leipsic M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″
June 29	13 14 5	10 4 47	+10 37 35

The comet has also been observed at Berlin and South Villa.

	1851.	h m s		R.A. ° ′ ″	Decl. ° ′ ″
Berlin,	July 1	13 21 29	Berlin M.T.	12 18 40·3	+10 40 28·5
South Villa,	4	13 4 59	Green. M.T.	15 37 32·0	+10 48 20·0

Elements. By MM. G. Rümker and E. Vogel.

Perihelion Passage, 1851, July 6·14735, Berlin M.T.

	° ′ ″	
Long. of Perihelion ...	324 19 44	App. Equinox, 1851, July 6.
— Node	152 40 44	
Inclination	14 39 36	

Log. Perihelion Distance (log. q) 0·089026. Motion direct.

IRENE.

On the Discovery of a Fourth New Planet, at Mr. Bishop's Observatory, Regent's Park. By Mr. Hind.

"At 12^{h} 45^{m} mean time, on the night of the 19th of May, 1851, during an examination of the heavens near the star Lalande 29490, I remarked an object of very nearly the same degree of brightness, following the star $8^{s}\cdot5$ in right ascension, and about $2'\frac{1}{2}$ to the *south*. I had previously (in 1850) had my attention directed to a *star of the 9·10th* magnitude, which follows Lalande's about 10^{s},

and 2′ to the *north*, and consequently was pretty well convinced that no star of the 9th magnitude then occupied the position of the stranger, as it could not have been overlooked; the region of the heavens in the 16th hour of right ascension, and between 10° and 15° south of the equator, is one with which I am very closely acquainted, and to this familiarity with the telescopic stars gained by repeated examinations in 1847, I must attribute the discovery of a fourth planet, as I have before had occasion to attribute to it the detection of the new star in *Ophiuchus*, found on the 27th of April, 1848.

"The low power which was on the telescope at the time was immediately changed for the wire-micrometer, and comparisons of the suspicious object with Lalande's star were commenced at 12^h 51^m 54^s mean time, when the difference of right ascension was $8^s{\cdot}3$. At 13^h 4^m 53^s mean time, the difference was found to be $7^s{\cdot}7$, a change quite great enough to be beyond doubt, and from this time numerous differential observations were taken with the view of ascertaining the direction of the planet's motion, for of the planetary nature of the newly-discovered object I was now convinced.

"A mean of the whole gave for 13^h 9^m 30^s Greenwich time,—

Right ascension of planet greater than that of star.... $7^s{\cdot}52$
Right ascension of planet south of the star ....$2'\ 36''{\cdot}1$*

"On the night of the discovery it was remarked that there was a decided contrast between the light of the star and that of the planet; the former was very white and vivid, while the latter had a dull bluish tinge. The planet also appeared to be enveloped in an extremely faint nebulous atmosphere, the existence of which has been confirmed on several subsequent occasions, though it requires a perfectly clear night and great attention to render it very evident.

"Sir John Herschel, who kindly undertook the selection of a name for this, the fourteenth member of the ultra-zodiacal group, has suggested *Irene* as one suitable to the present time, the symbol to be a dove carrying an olive-branch with a star on the head; and since the announcement of this name, I have been gratified in receiving from all quarters the most unqualified expressions of approbation.

"There is one remarkable circumstance in the history of the discovery of *Irene*, which shows how closely the heavens are now examined, and how observers at distant stations, and without any

* Mr. Main, in the absence of the Astronomer Royal, has been good enough to send me the following places of Lalande 29490.

"The mean place of Lalande 29490, with which star Mr. Hind first compared the planet, is as follows, from five observations:—

	R.A.	N.P.D.
	h m s	° ′ ″
1851·0	16 4 0·51	103 20 56·4

"The Apparent Place on May 19 is

R.A.	N.P.D.
h m s	° ′ ″
16 4 2·10	103 20 56·9

communication with each other, are guided by experience into the same methods for prosecuting a search for planets. I allude to the independent discovery of the new planet by Dr. De Gasparis at the Royal Observatory of Naples, only *four days after my own*, intelligence of which reached London on the morning of Wednesday last, the 11th of June.

"The elements of *Irene* have been calculated by MM. Vogel and George Rümker, and their orbit represents the observed places up to June 10 with great accuracy. It places *Irene* between *Parthenope* and *Egeria* in order of mean distance from the sun, the period of revolution being 1490 days, or 4·08 years. The positions of the lines of nodes and apsides, and of the plane of the orbit, agree nearly with those of the orbit of *Ceres*.

"It is worthy of notice that a star of the 9th magnitude, observed by Bessel in zone 249, right ascension (1825), $16^h\ 4^m\ 21^s{\cdot}81$, north polar distance $= 104^\circ\ 32'\ 26''{\cdot}9$ has disappeared from its place, which is little more than 1° distant from the position occupied by *Irene* at the time of her discovery. Unless, however, the period of revolution assigned to this planet by MM. Vogel and Rümker admits of a large correction (which at present seems improbable), I think the object observed by Bessel, though in all probability a planet, was not the one just brought to light. A month or six weeks' longer observation of *Irene* may furnish elements which will enable us to decide this point."

Observations.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

	Greenwich M.T.	R.A.	$\text{Log}\,\frac{p}{P}$	N.P.D.	$\text{Log}\,\frac{q}{P}$	Star of Comp.
1851.	h m s	h m s		° ′ ″		
June 10	12 34 40·4	15 43 42·60	+8·292	104 12 21·3	−9·9559	γ Libræ
	12 58 36·8	41·86	+8·367	23·2	·9520	—
	13 32 33·2	40·90	+8·426	28·5	·9475	—
15	10 29 46·2	15 40 14·12	+7·333	104 28 10·2	·9651	—
	10 54 42·5	13·56	+7·820	13·7	·9642	—
	11 19 38·4	12·79	+8·041	16·6	·9628	—
16	9 55 17·2	15 39 37·18	−7·509	104 31 31·7	·9652	—
	10 20 13·1	36·24	+7·099	35·7	·9653	—
	10 45 9·2	35·65	+7·758	39·4	·9648	—
17	10 11 42·0	15 38 60·00	+6·731	104 35 6·7	·9656	—
	11 1 34·2	58·66	+7·975	14·4	·9636	—
July 16	9 55 10·3	15 33 41·92	+8·269	106 46 0·1	·9634	B.A.C.5257
	10 37 5·8	42·08	+8·398	7·8	·9556	—
17	9 59 27·7	15 33 56·47	+8·298	106 51 20·6	·9624	—
	10 19 25·3	56·43	+8·361	23·7	·9587	—
18	10 19 46·1	15 34 12·82	+8·373	106 56 47·2	·9580	—
	10 39 44·5	13·16	+8·423	47·8	·9536	—
21	10 12 55·2	15 35 11·14	+8·381	107 13 8·0	·9581	—
	10 32 53·9	11·46	+8·430	13·2	−9·9536	—

The observations are corrected for refraction. The corrections to be applied for parallax in time and arc are represented by p and q. P is the equatoreal horizontal parallax.

The following are the assumed *mean* places of the stars of comparison for 1851·0, derived from the Greenwich 12-year Catalogue:—

	R.A. h m s	N.P.D. ° ′ ″
γ Libræ	15 27 11·83	104 17 19·49
B.A.C. 5257	15 45 20·87	106 17 15·98

GREENWICH. Meridian Circle. (The Astronomer Royal.)

1851.	Green. M.T. h m s	R.A. h m s	N.P.D. ° ′ ″
May 28	11 31 38·3	15 55 15·16	103 39 10·0
29	26 44·2	54 16·87	41 15·0
30	21 51·2	53 19·64	43 23·0
31	16 58·6	52 22·77	45 39·5
June 2	11 7 15·8	50 31·44	50 23·9
4	10 57 36·6	48 43·85	103 55 20·9
16	10 1 20·3	39 36·92	104 31 33·4
17	9 56 47·9	39 0·41	35 3·1
19	9 47 47·9	15 37 52·02	104 42 13·0

Not corrected for parallax.

DURHAM. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1851.	Greenwich M.T. h m s	App. R.A. h m s	Log $\frac{p}{P}$	App. N.P.D. ° ′ ″	Log $\frac{q}{P}$	No. of Comps. in R.A.	N.P.D.	Set.
June 10	12 11 41·1	15 43 43·32	+8·210	104 12 13·3	−9·9628	24	8	11
12	12 10 4·4	42 14·37	·240	18 31·7	·9624	12	4	12
15	11 11 19·7	40 13·14	·005	28 18·5	·9672	7	7	13
	12 16 44·9	11·33	·315	23·6	·9594	18	6	14
16	11 25 10·6	39 34·53	·123	31 42·9	·9656	24	8	15
17	11 51 12·0	38 57·35	·258	104 35 18·0	·9622	12	4	16
26	11 41 29·8	34 43·54	·354	105 10 16·4	·9588	24	8	17
	12 6 5·9	42·86	·415	18·6	·9540	23	8	18
28	11 42 53·3	34 5·63	·382	18 46·6	·9573	8	4	19
29	11 20 51·8	33 49·46	·332	23 5·3	·9607	20	7	20
	11 48 24·3	49·32	·405	12·2	·9554	12	6	21
30	11 19 46·9	33 35·04	·343	27 31·5	·9601	23	8	22
July 4	11 22 0·8	15 32 54·97	+8·393	105 45 56·4	−9·9573	17	6	23

P is the equatoreal horizontal parallax in seconds of arc; p and q are the required corrections in time and arc respectively.

Mean Places of Stars of Comparison, 1851·0.

Name.		R.A. h m s	N.P.D. ° ′ ″	Set.
Weisse, xv^h,	864	15 44 56·62	104 15 51·5	11, 12
—	838	43 16·56	24 31·5	13
B.A.C.	5188	35 4·00	104 33 40·0	14, 15, 16
Weisse, xv^h,	644	33 40·03	105 5 5·7	17
B.A.C.	5190	35 41·85	11 39·0	18, 19, 20
—	5184	15 34 23·60	105 31 57·7	21, 22, 23

June 12. Sky clear for a very short time.
15, 16. High wind. The hearing tube used on the 15th.
17. Much interrupted by cloud.
28, 29. Planet very faint.
July 4. No choice of stars. Diff. of N.P.D. large.
5 to 14. Continued cloudy weather. Obs. discontinued.

COLLEGIO ROMANO. Meridian Circle. (Father Secchi.)

1851.	Rome M.T. h m s	App. R.A. h m s	App. Decl. ° ′ ″
May 29	11 26 54·4	15 54 18·93	−13 41 17·8
30	22 1·5	53 21·77	43 20·3
31	17 8·9	52 24·89	45 38·5
June 1	12 17·0	51 28·77	47 56·1
2	7 26·3	50 33·77	50 19·8
3	11 2 36·4	49 39·72	52 44·3
5	10 52 58·8	47 53·60	13 57 48·2
6	10 48 15·6	15 47 1·88	−14 0 36·3

Micrometrical Observations.

1851.	Rome M.T. h m s	R.A. Planet. m s	Decl. Planet. ′ ″		Obs.	Microm.
May 31	11 39 7·7	=✱+2 31·7	=✱−5 3·4	48 Libræ	3	Circ.
June 1	9 15 14·8	+1 41·5		— —	3	Circ.
	11 40 17·8	+1 35·08	−2 43·7	— —	4	Wire
2	9 21 16·2	+0 44·78	−0 36·1	— —	5	Circ.
	9 53 54·8	+0 43·50	−0 33·3	— —	3	Wire
	11 34 55·4	+0 39·27	−0 23·3	— —	4	Wire
3	9 34 29·8	−0 10·39	+1 42·6	— —	3	Circ.
	11 52 44·7		+1 52·8	— —	4	Wire
	11 54 39·6	−0 15·53		— —	4	Wire
5	9 35 41·3		✱+0 17·3	H.C. 28969	3	Wire
	9 54 31·2	+0 0·2		— —	4	Circ.
	10 52 58·8	−0 2·7		— —		Mer. Passage

HAMBURG. (M. C. Rümker.)

1851.	Hamburg M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″	
June 4	10 22 43·5	237 10 45·8	−13 56 32·8	Equatoreal
	10 57 42·0	41·4	41·6	Merid. Circle
18	10 52 0·2	234 36 14·2	14 38 45·3	Equatoreal
19	10 47 29·9	27 59·5	42 23·0	—
21	10 40 46·5	234 12 27·8	14 49 52·3	—
28	11 34 57·4	233 31 33·8	15 18 48·1	—
29	11 13 52·6	27 35·9	22 54·3	—
30	10 58 51·8	23 58·4	27 17·7	—
July 1	10 57 56·6	20 46·1	31 42·3	—
2	10 53 24·8	18 4·8	36 22·1	—
3	11 23 22·7	233 15 51·3	−15 40 53·8	—

Not corrected for parallax.

HAVERHILL. (Mr. W. Boreham.)

1851.	Greenwich M.T. h m s	R.A. h m s	s	N.P.D. ° ′ ″	″	No. of Obs.	Star of Comp.
May 21	11 0 2	16 2 14·89	−0·012 P	103 26 25·6	−0·904 P	6	*a*
22	11 6 40	1 14·25	·012	28 1·1	·903	6	*a*
23	10 33 51	16 0 16·60	·013	29 41·2	·903	7	*b*
28	11 15 39	15 55 16·33	·003	39 10·8	·911	5	*b*
30	11 16 28	53 19·59	·000	43 21·8	·912	3	*c*
31	10 21 14	52 25·22	·009	45 32·9	·908	6	*c*
June 1	10 31 25	51 28·14	·006	47 52·3	·911	5	*c*
4	10 28 31	48 45·00	−0·005	103 55 16·0	·912	6	*c*
16	11 55 2	39 34·33	+0·020	104 31 44·8	.898	5	*d*
17	11 33 46	38 57·28	·017	35 8·0	·904	5	*e*
19	10 31 36	37 50·65	·009	42 26·3	·916	3	*f*
21	10 47 27	36 48·81	·012	49 57·5	·913	5	*f*
22	10 26 30	36 20·62	·009	104 53 46·1	·916	6	*f*
24	10 37 42	35 28·51	·013	105 1 47·0	·914	5	*g*
26	10 20 36	15 34 44·09	+0·012 *p*	105 9 59·1	−0·916 *p*	6	*g*

P = horizontal equatoreal parallax in arc.

	Mean Places, 1851·0. R.A. h m s	N.P.D. ° ′ ″
a = Weisse xvi^h, 38	16 2 43·22	103 35 54·3
b = — xv^h, 1118	15 58 46·02	40 0·5
c = Greenwich 12-year Catalogue, 1308	49 51·10	103 50 43·2
d = Weisse xv^h, 744	38 44·80	104 46 7·6
e = — — 705	36 37·41	41 56·6
f = Greenwich 12-year, No. 1282 = B.A.C. 5188	35 3·95	104 33 39·7
g = — — — 1283 = — 5190	15 35 41·86	105 11 38·8

Elements.

Calculated by M. Fergola, of the Royal Observatory, Naples.

Epoch 1851, June 1·0, Greenwich M.T.

	° ′ ″	
Mean Anomaly	44 5 32·3	
π	185 27 33·4	Mean Equinox of Epoch.
☊	87 16 29·6	Mean Equinox of Epoch.
i	8 52 28·6	
ϕ	8 50 10·5	
Log a	0·4078482	
μ	867″·4298	

The elements are based upon Mr. Hind's observation of May 19, and the Neapolitan observations of May 25 and June 3.

By Mr. R. C. Carrington, of the Durham Observatory.*

"From Hind's first observation and the Durham observations of May 31 and June 15 I have computed the following approximate Elements by the method of Gauss, carried to two approximations to P and Q:—

1851, June 1·0.

Mean longitude	$M = 227° 43' 36''·66$	Mean Equinox. Jan. 0.
Longitude of perihelion	$\varpi = 180\ 42\ 49·74$	
— ascending node.	$N = 87\ 2\ 39·04$	
Inclination	$I = 9\ 0\ 18·20$	
Angle of excentricity	$\phi = 9\ 28\ 10·80$	
Mean diurnal motion	$\mu = 858''·1956$	

"Residual errors.

Computed—Observed Places.

R.A.	$-0^s·55$	$+0^s·55$	$+0^s·43$
N.P.D.	$+1''·17$	$+1''·05$	$+0''·92$

"Heliocentric co-ordinates. (u = excentric anomaly.)

$$x = [0·4055744] \sin(u + 270° 40' 3''·98) + 0·4185795$$
$$y = [0·3670459] \sin(u + 184\ 42\ 30·08) + 0·0314439$$
$$z = [0·0390821] \sin(u + 161\ 1\ 46·50) - 0·0585202$$

By Mr. Norman Pogson, from the following Observations:—

1851.	h m s	R.A. h m s	N.P.D. ° ' "	
May 21	12 5 41·8	16 2 11·99	103 26 28·5	Cambridge.
31	10 53 59·1	15 52 23·74	103 45 38·0	Liverpool.
June 10	12 58 36·8	15 43 41·79	104 12 24·4	Liverpool.

Mean Anomaly ...	48° 13' 33''·72	June 1, 0h Greenwich M.T.
ϖ	178 37 41·88	Mean Equinox, June 1d·0h.
☊	86 50 1·60	
i	9 6 22·08	
ϕ	9 47 20·75	
e	0·1700220	
Log a	0·4126288	
Log q	0·3316958	
Log μ	2·9310634	
μ	853''·2248	

Sidereal period, 1518·94345 days.

The middle observation is represented in longitude within +0''·42, and in latitude within −0''·08; Observed — Computed place.

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* "Mr. Carrington wishes to call the attention of those Fellows of the Astronomical Society who may call at the Society's apartments to a model which he left there some months ago of the orbits of the *Asteroids*, then 13. His object in doing so was to illustrate a certain convergency or *bundling up of the orbits at about* 182° *of longitude.* Two new planets having conformed to the view taken since it was first entertained, he thinks it may not be improper to call more decided attention to the circumstance."

By MM. E. Vogel and G. Rümker.

	° ′ ″	
Mean Anomaly ...	55 4 49·67	July 10, 1851, Berlin M.T.
Long. Perihelion ..	179 9 55·01	Mean Equinox,
— Node	86 51 3·89	Jan. 0, 1851.
Inclination	9 5 47·03	
φ	9 39 47·64	
Log e	9·2249390	
Log a	0·4124446	
Log μ	2·9313397	

Ephemeris. By Mr. N. Pogson, and MM. Vogel and G. Rümker, from their preceding Elements.

For Greenwich Mean Midnight.

1851.	R.A. h m s	N.P.D. ° ′	478· Δ. m s	Hor. Par. ″	Log Δ.
July 1	15 33 22	105 31·9			
2	33 12	36·5			0·19555
3	33 3	41·2			
4	32 55	45·9			
5	32 50	50·6			
6	32 46	105 55·5			·20708
7	32 44	106 0·3			
8	32 44	5·2			
9	32 45	10·2			
10	32 50	15·2	13 46·7	5·17	·21891
11	32 54	20·2			
12	33 1	25·3			
13	33 9	30·5			
14	33 19	35·8	14 9·9	5·03	·23095
15	33 31	41·1			
16	33 44	46·4			
17	33 59	51·7			
18	34 16	106 57·1	14 34·1	4·89	·24312
19	34 34	107 2·5			
20	34 54	8·0			
21	35 15	13·5			
22	35 38	19·0	14 59·2	4·75	·25535
23	36 2	24·5			
24	36 28	30·1			
25	36 55	35·8			
26	37 24	41·5	15 24·9	4·62	·26757
27	37 54	47·2			
28	38 26	52·9			
29	38 59	107 58·6			
30	39 34	108 4·3	15 51·2	4·49	0·27974
July 31	15 40 10	108 10·0			

1851.	R.A. h m s	N.P.D. ° ′	478ᵐ Δ. m s	Hor. Par. ″	Log Δ.
Aug. 1	15 40 47	108 15·8			
2	41 25	21·6			
3	42 5	27·4	16 18·1	4·37	0·29181
4	42 46	33·2			
5	43 28	39·1			
6	44 12	44·9			
7	44 58	50·8	16 45·5	4·25	·30379
8	45 45	108 56·7			
9	46 32	109 2·6			
10	47 21	8·5			
11	48 11	14·4	17 13·2	4·14	·31557
12	49 2	20·3			
13	49 54	26·2			
14	50 48	32·1			
15	51 43	38·0	17 41·2	4·03	·32719
16	52 39	43·9			
17	53 36	49·8			
18	54 34	109 55·6			
19	55 34	110 1·4	18 9·4	3·93	·33860
20	56 35	7·2			
21	57 36	13·1			
22	58 38	18·9			
23	15 59 41	24·7	18 37·9	3·83	·34978
24	16 0 46	30·5			
25	1 51	36·3			
26	2 57	42·1			
27	4 4	47·9	19 6·5	3·73	·36072
28	5 12	53·7			
29	6 21	110 59·5			
30	7 31	111 5·2			
31	16 8 42	111 10·9	19 35·3	3·64	0·37139

The elements and ephemeris of *Irene* were computed by Mr. N. Pogson at the particular request of the Editor. Mr. Pogson is now attached to the Radcliffe Observatory.

An Ephemeris for 9^h 36^m Berlin Mean Time, computed by MM. Vogel and G. Rümker from their own elements, was very kindly forwarded by our associate M. C. Rümker, but it was received after Mr. Pogson's Ephemeris was set up. On reducing the Ephemerides to the same date they are so nearly identical, that it has not been thought worth while to print both, as both are only approximate.

HEBE.

HAMBURG. (M. C. Rümker.)

1851.	Hamburg M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″
July 3	10 40 56	291 44 47·6	−8 8 30·3
5	10 51 9	291 17 32·0	−8 22 0·9

Not corrected for parallax.

Durham. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1851.	Green. M.T. h m s	App. R.A. h m s	Exc. of Ephem. s	App. N.P.D. ° ′ ″	Exc. of Ephem. ″	No. of Comps. in R.A.	N.P.D.	Set.
June 17	13 7 48·4	19 38 49·31	...	96 53 44·0	...	15	5	1
26	12 56 56·7	32 45·57	−1·07	97 29 4·1	−4·6	24	8	2
27	13 7 50·9	31 58·07	1·12	34 9·1	3·1	24	8	3
29	12 39 6·5	30 20·85	0·75	44 52·6	4·2	24	8	4
30	12 9 0·8	29 31·42	0·76	97 50 30·1	4·6	24	8	5
July 4	13 0 43·7	25 58·40	1·02	98 15 52·5	4·2	24	8	6
6	10 47 19·5	19 24 13·14	−0·99	98 29 6·0	−5·6	24	8	7

The above observations are corrected for refraction and parallax, and compared with the ephemeris contained in the supplement to the *Nautical Almanac* for 1854.

Mean Places of Stars of Comparison, 1851·0.

Name.	R.A. h m s	N.P.D. ° ′ ″	Set.
Weisse, xix^{h}, 895	19 34 47·33	96 49 15·3	1
B.A.C. 6713	28 52·47	97 21 15·4	2, 3
Weisse, xix^{h}, 689	27 26·87	97 46 52·9	4, 5
— — 621	24 52·78	98 18 40·0	6
— — 561	19 22 36·85	98 29 33·4	7

June 17, clouds troublesome; planet a good 8th magnitude. The six following observations of *Hebe* were all taken under unusually favourable circumstances.

The minutes in declination of Weisse, xix^{h}, 689 should be 50′, not 49′, for 1825; the star is given correctly in Bessel's Zone. Also the precession in R.A. of xix^{h}, 621 should be 3^{s}·255, not 2^{s}·887, which latter corresponds to a + declination.

Liverpool. Equatoreal. (Mr. Hartnup.)

1851.	Green. M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	Comp^{d}—Obs^{d}. R.A. s	N.P.D. ″
July 17	11 14 51·6	19 13 37·57	99 58 45·1	−1·15	−2·9
	11 34 48·0	36·86	51·3	1·24	1·6
18	11 19 57·3	19 12 39·55	100 7 53·2	1·32	1·8
	11 39 53·4	38·72	59·5	−1·29	−0·4

The observations are corrected for refraction and parallax. The parallax and computed places were deduced from the ephemeris contained in the supplement to the *Nautical Almanac*, 1854.

The following is the assumed *mean* place of the star of comparison for 1851·0, derived from the Greenwich and Edinburgh observations:—

	R.A. h m s	N.P.D. ° ′ ″
B.A.C. 6564	19 4 35·76	98 11 1·55

Ephemeris of Parthenope, calculated from the Elements No. III. (Astronomische Nachrichten, No. 763), for Berlin Mean Midnight. By M. Luther.

12^{h}, Berlin Mean Time.

1851.	App. R.A. h m s	Diff. m s	App. Decl. ° ′ ″	Diff. ′ ″	Log. Δ	Diff.	Aberr. Time in Decimals of a Day.	Diff.
July 12	1 40 2·15	1 14·96	+6 8 10·8	+4 49·8	0·32588	223	0·01209	6
13	41 17·11	1 14·17	13 0·6	4 42·8	0·32365	225	0·01203	7
14	42 31·28	1 13·38	17 43·4	4 35·9	0·32140	225	0·01196	6
15	43 44·66	1 12·56	22 19·3	4 28·7	0·31915	228	0·01190	6
16	44 57·22	1 11·73	26 48·0	4 21·6	0·31687	228	0·01184	6
17	46 8·95	1 10·87	31 9·6	4 14·4	0·31459	230	0·01178	6
18	47 19·82	1 10·01	35 24·0	4 7·0	0·31229	231	0·01172	7
19	48 29·83	1 9·12	39 31·0	3 59·7	0·30998	233	0·01165	6
20	49 38·95	1 8·21	43 30·7	3 52·2	0·30765	234	0·01159	6
21	50 47·16	1 7·29	47 22·9	3 44·7	0·30531	235	0·01153	6
22	51 54·45	1 6·34	51 7·6	3 37·1	0·30296	236	0·01147	7
23	53 0·79	1 5·38	54 44·7	3 29·4	0·30060	238	0·01140	6
24	54 6·17	1 4·39	6 58 14·1	3 21·6	0·29822	239	0·01134	6
25	55 10·56	1 3·38	7 1 35·7	3 13·8	0·29583	240	0·01128	6
26	56 13·94	1 2·36	4 49·5	3 5·9	0·29343	241	0·01122	6
27	57 16·30	1 1·31	7 55·4	2 57·9	0·29102	242	0·01116	7
28	58 17·61	1 0·25	10 53·3	2 49·9	0·28860	243	0·01109	6
29	1 59 17·86	0 59·17	13 43·2	2 41·9	0·28617	244	0·01103	6
30	2 0 17·03	58·07	16 25·1	2 33·7	0·28373	245	0·01097	6
31	1 15·10	56·94	18 58·8	2 25·5	0·28128	247	0·01091	6
Aug. 1	2 12·04	55·81	21 24·3	2 17·2	0·27881	247	0·01085	6
2	3 7·85	54·65	23 41·5	2 9·0	0·27634	248	0·01079	7
3	4 2·50	53·47	25 50·5	2 0·7	0·27386	248	0·01072	6
4	4 55·97	52·27	27 51·2	1 52·2	0·27138	250	0·01066	6
5	5 48·24	51·07	29 43·4	1 43·9	0·26888	250	0·01060	6
6	6 39·31	0 49·82	31 27·3	+1 35·4	0·26638	251	0·01054	6
7	2 7 29·13		+7 33 2·7		0·26387		0·01048	

ASTRÆA.

HAMBURG. Equatoreal. (M. C. Rümker.)

1851.	Hamburg M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″	Obs.
May 4	10 36 59·0	217 33 7·3	−5 29 11·0	9
7	10 12 15·3	216 54 22·5	17 27·3	2
8	9 52 0·5	41 57·3	13 56·9	20
10	10 22 39 3	216 16 46·0	5 7 3·1	23
17	10 2 51·3	214 56 56·6	4 48 14·8	18
21	9 54 51·4	214 17 14·0:	−4 41 16·3:	2

Not corrected for parallax.

Mean Places for January 0·1851 of Stars in the Orbit of *Astræa*, deduced from Observations with the Meridian Circle.

R.A. h m s	Precession. s	Decl. ° ′ ″	Precession. ″
14 16 28·20	+3·131	−4 38 35·0	−16·60
18 43·78	3·135	49 1·1	16·50
49 27·65	3·136	50 23·5	16·46
25 18·87	3·138	4 49 12·5	16·15
25 22·13	3·142	5 7 56·6	16·15
27 37·53	3·143	10 39·6	16·04
14 31 10·34	+3·144	−5 8 23·4	−15·85

On the Observation of the Solar Spots with large Telescopes. By the Rev. W. R. Dawes.

"The appearance of the solar spots is greatly modified by the aperture of the telescope employed in observing them. A large aperture, by reducing the telescopic irradiation, produces a hardness and sharpness of outline which cannot be attained by a diminished aperture, and brings out minute details which would never be suspected with a small telescope, however perfect. It may be some time before the admirable suggestion of Sir John Herschel, to make large solar reflecting telescopes with glass mirrors, will be realised, however desirable may be its accomplishment; and even then such instruments will be suited for that purpose only.

"Various methods have been proposed of preserving the darkening glasses, which it is necessary to employ, from the destructive effect of the excessive heat collected by a large object-glass. None of these, as far as I am aware, has proved completely successful. If a combination of coloured glasses is placed at a considerable distance before the eye-piece, so as to receive the rays before they come to focus, according to Mr. Lawson's proposal, the glasses are still exposed to frequent fracture, if the distance from the focus is not very great in proportion to the whole focal length; and if that distance should be much increased, the coloured glasses must be of large size to receive the whole of the rays from the object-glass, and their quality must be nearly as perfect as that of the object-glass itself, or the focal image will be confused and unsatisfactory. But, notwithstanding the objections to the use of this method, its effect on the appearance of the spots and of the sun's disk generally is so striking, as to render it highly desirable that some arrangement should be devised, by which the sun may be examined with an object-glass of the largest dimensions, without the risk of destruction to the coloured glasses, or of injury to the eye of the observer.

"I have lately employed a mode of observation which enables me to use the whole aperture of my 8½-foot refractor (6⅓ inches) without the slightest inconvenience. Its simplicity is such as to render it extremely probable that it may already have been employed by other more diligent observers of the sun than myself; but as I have never met with any hint of it, some other observer

may perhaps be glad of a suggestion which will save his glasses and secure the safety of his eye; and thus enable him to enjoy without apprehension the extraordinary phenomena which the sun's surface frequently presents when viewed with a large telescope.

"The method consists simply in *diminishing the aperture in the field-bar* of the eye-piece to any extent which the observer may find requisite or convenient. It is obvious that this does not lessen the brightness of the portion of the sun's image which is visible through the aperture of the field-bar; but by diminishing the area from which light and heat are transmitted to the eye, that portion may be viewed with safety, however large may be the aperture of the object-glass. The field-bar, however, being placed at the focus of the object-glass, will receive all the heat concentrated by it, with the exception of the small portion passing through its central aperture; and it will thus very soon become so greatly heated as, by its contact with the interior of the eye-tube, to render the whole of it very inconveniently hot. This I have obviated in my own telescope by letting the field-bar touch the eye-tube in three points only, the rest of its circumference being filed away; and though with this arrangement some heat is still communicated, it is in no inconvenient quantity. But it might probably be almost entirely prevented by setting the field-bar in some substance which is a bad conductor of heat.

"To determine the largest diameter of the aperture in the field-bar which it may be safe to employ, it is only requisite to decide upon the diameter of an object-glass which might certainly be used without danger. I believe that, under the most intense solar heat in this climate, an object-glass of two inches in diameter will not endanger a well-annealed coloured glass; but any smaller diameter may be adopted as the standard; and whatever that may be, the size of the field-bar in any given instance is readily computed.

"Putting O = diameter of the large object-glass in inches and decimals,
F = its focal length similarly expressed,
o = diameter of standard object-glass considered safe to employ,
d = required diameter of field-bar,

we have $$d = \frac{F \times o \times 2 \sin \odot\text{'s } \tfrac{1}{2} \text{ diameter}}{O}.$$

"Thus, in the case of my own refractor, O = 6·34; F = 102·5; and if o be assumed = 2 inches, and the sun's semi-diameter = 16′ 1″, we shall have $d = \frac{102{\cdot}5 \times 2 \times {\cdot}00932}{6{\cdot}34} = 0{\cdot}301$.

"By using a field-bar, therefore, whose diameter is three-tenths of an inch, the heat transmitted to the eye-glass is reduced to that which would be received from the whole disk of the sun, if the diameter of the object-glass were reduced to 2 inches. In my refractor, about one-tenth of the sun's area is the proportion embraced *by such a* field-bar. But though I believe that this does not exceed

what may be safely admitted, I have usually employed a field-bar of scarcely half that diameter, as being abundantly sufficient for the examination of the largest spots, or even groups of spots.

"In the formula, the eye-piece is supposed to be a convex single lens, or a positive double eye-piece, which, with so small a field of view as the field-bar affords, is quite as convenient as the usual astronomical eye-tube, in which the field lens diminishes the focal image, and in a variable degree with various magnifying powers, necessitating an adjustment of the size of the field-bar to each; while, with the use of single lenses, the power may be varied at pleasure, without changing the dimensions of the field-bar.

"But not only may the minute details of the solar spots be thus examined with all the advantage afforded by the use of a large telescopic aperture. Other very interesting results are also obtainable by the same means. Especially may the heating power of the various parts of the sun's disk be submitted to measurement. And on the occurrence of a solar spot with a large nucleus, by employing a field-bar which would only just embrace that nucleus, the going of the equatoreal driving clock being nicely adjusted, the constitution of the apparently black portion might be examined, and the fact ascertained whether it be actually devoid of light, or whether its light is only so comparatively feeble as to be extinguished by the deep colour of the glass rendered needful by the smallest portion of the sun's bright surface.

"There is one fact to which, though not necessarily connected with the subject of the present paper, I would take this opportunity of drawing attention, as it may, perhaps, be found useful in other observations; and especially in those of some of the phenomena attending a total eclipse of the sun. It is this: *that the same telescopic focus is not equally good on all portions of the sun's surface.* This may be satisfactorily proved when there are well-defined spots near his centre, and also near the edge of his disk: and the difference will be more obvious with a rather low power, such as 40 to 100, on telescopes whose focal length is from 30 to 60 inches. The focus having been accurately adjusted on a spot near the centre, it will be found to require *lengthening* when a spot near the edge is brought into the same part of the field, and *vice versâ*. To ascertain whether this originated in any peculiarity of my own eye, I requested Mr. Hind to try the experiment, without intimating to him on which side the difference of focus lay. He was kind enough to do so, and arrived at precisely the same conclusion as myself. There can therefore be no doubt of the fact; and it is evidently to be attributed to the effect upon the eye of different intensities of light. Indeed I have frequently noticed the same result in passing immediately from one object to another differing much in brightness. Thus, the best focus on the bright edge of the moon will require lengthening when the feebly enlightened portions are brought into the same place in the field of the telescope, or in the examination immediately afterwards of such an object as *Saturn*. And perhaps some of the curious anomalies which have attended

lunar occultations may partly arise from this source. Observers have often stated that, previous to an occultation, the focus of the telescope has been carefully adjusted on a small and close double star: and if, with that focus, the disappearance of a star be observed at the bright edge of the moon, the probability is that, the greater stimulation of the eye having altered its focus, some clinging to the moon's edge, or even projection on its disk, may be the result. The involuntary shortening of the focus of the eye under the stimulus of light, evidently arises from the diminution of the pupil and the consequent drawing forward of the crystalline lens, and is analogous to the variation produced by looking at near and remote objects: but it is very possible that the amount of variation required in the adjustment of the focus of a telescope may differ with different degrees of sensibility in the eye.

"I would beg leave to suggest to those observers who intend to look out for the delicate phenomena attending a total eclipse of the sun, such as Baily's beads and the red flames in the corona, that it might be well to keep this fact in view, which does not appear to be so generally known as it deserves: at least, among those to whom I have mentioned the subject, there was no one who seemed to be aware of it.

"It would seem highly desirable that this or some other equally efficient method of employing the whole aperture should be adopted in observing the sun's transit with large instruments, and in measuring his diameter with large meridian circles and heliometers. The diameter of the sun, as well as of all other celestial bodies, is unquestionably smaller with a large aperture than with a small one, provided the state of the atmosphere is not too unfavourable for its advantageous employment. Though the difference is not so striking on objects having a sensible diameter as on the disks of the fixed stars, yet it exists; and may be readily subjected to experiment in any large telescope whose whole aperture is sufficiently perfect."

Remarks on the Observations of the Obscure Portion of Saturn's Ring, made by Dr. Galle, at Berlin, in the year 1838. By the Rev. W. R. Dawes.

"In the *Astronomische Nachrichten*, No. 756, there is a paper by Dr. Galle, dated 1851, April 1, in which he refers to a communication of Professor Encke's, published in the *Transactions of the Berlin Academy of Sciences* for 1838, as containing some observations on the dark ring of *Saturn*, made by Dr. Galle with the Berlin refractor, which is, I believe, of the same dimensions as the refractor at Dorpat (aperture 9 inches, and focal length 14 feet, Paris measure), and by the same maker.

"On referring to the volume in the Society's library, I found that no part of it was cut open. Professor Encke's paper is illustrated by two pictures of *Saturn*, in which the exterior ring is *shown with* a broad division at the ansæ, nearly in the middle of

its breadth. But there is no indication in the pictures of any encroachment of the inner ring on the black interval between it and the ball. On looking into the paper itself, however, I find the following remarks on this point by Dr. Galle, who is stated to have been the principal observer with the large refractor in the year 1838.

"'1838, May 8. Air very good. The inner edge of the inner ring is faded.

"'May 25. The dark space between *Saturn* and his ring seemed to M. Galle to consist, as far as its middle, of the gradual extension of the inner edge of the ring into the darkness, so that the fading of this inner ring has considerable breadth.

"'June 10. The inner edges of the first ring fade away gradually into the dark interval between the ring and the ball. It seemed, if no illusion exists, that the ring, from the beginning of the shading inclusive, extends over nearly half the space towards the ball of *Saturn*.

"'June 15. *Saturn* very distinct. The fading of the inner ring towards *Saturn*, as on June 10.'

"No measurements of this appearance are given in Encke's paper; indeed he does not appear to have seen anything of it himself: and it is to be observed that the pictures refer to the aspect of the planet as seen by him 1837, April 25; and 1838, March 10; being before the observations of Galle, who has recently published (in No. 756 of the *Astronomische Nachrichten*), six days' micrometrical measurements subsequently obtained by himself. These show that he saw the obscure portion of the ring encroaching on the black interval between the ring and the ball to almost precisely the same extent as it appeared to myself at the last apparition of the planet, namely, about 2″. This is a peculiarly interesting fact, as rendering it highly probable that this is really the interior *limit* of the obscure ring. And this idea is supported by the small breadth of the dark line formed by its projection on the ball; which, in fact, appears to be so narrow as scarcely to be consistent with the visible breadth of the dark ring at the ansæ. It is remarkable that no intimation is given by Dr. Galle, that this projection was seen either by himself or any other observer; nor does it appear to have occurred either to Encke, Galle, or Mädler (who is referred to in Galle's observations), that so dull an appendage would be visible as a dark line upon the ball. But, since the ring presented at that time a very broad ellipse, such a dark line would be much broader and more visible than it was last winter. Why then, it may be asked, was it not observed on some of the very favourable nights on which the planet was scrutinised by the observers at the Berlin observatory? I think we may be justified in replying, that *it actually was seen*, but that its nature was not apprehended. For, in both the pictures appended to Encke's paper, there is a dark shading of considerable breadth below, or to the north of, the inner edge of the ring where it crosses the ball, which appears to be intended for the shadow of the ring upon the

ball. But the fact is, that on 1837, April 25, the elevation of the earth above the plane of the ring exceeded the elevation of the sun above the same plane by only 0'·7, according to the data in the *Nautical Almanac;* and consequently the visible shadow of the ring upon the ball must have been an excessively narrow line. And on 1838, March 10, the elevation of the earth above the plane of the ring was *precisely the same* as that of the sun; and there could therefore at that time be *no visible shadow* of the ring upon the planet. The shading in both the engravings must therefore, I imagine, have been *the obscure portion of the ring projected upon the ball;* but it was not recognised as such; and, consequently, the entire phenomenon was not so completely made out as it might have been. Yet Professor Encke seems to have had no doubt of the reality of Galle's observations; for, at the close of his paper, having referred to an observed apparent excentricity of *Saturn's* position in his ring, he uses the following remarkable language:—

"'I find it remarked in my journal on one occasion only, 1837, June 20, 16^h 45^m sidereal time, that I thought such an appearance was visible, so that the space between *Saturn* and the ring seemed rather greater on the right side in the telescope (the eastern) than on the left (the western). Probably the foregoing remark of M. Galle, that the gradual decrease of light of the inner ring towards the body of *Saturn* appeared to him to extend far into the interval between *Saturn* and the ring, may furnish an explanation. It does not appear that he was on any occasion deceived; since on the four days on which he measured *Saturn*, he has measured the wide extent of the dark covering; and on all the four days found it, with great accordance, of the same dimension. At least it would appear from this, that different eyes are able to see very differently the inner limit of the inner ring; and that even the relative estimation of the proportion of the two ansæ depends upon the observer himself.'

"It is to be regretted that Dr. Galle's observations and measures were not published in the *Astronomische Nachrichten* soon after they were made; as they would long since have directed attention to this remarkable phenomenon.

"It is interesting to remark that at that time the *northern* surface of the ring was visible, while at present the southern is seen; and that it may consequently be inferred, that no appreciable difference exists in the reflective power of the two surfaces of the dull portion.

"In looking for its projection on the ball at the ensuing apparition of the planet, it should be borne in mind, that when the elevation of the earth above the plane of the ring *exceeds* that of the sun, the shadow of the ring on the ball is visible at the interior (or southern) edge of the ring where it crosses the planet; and that therefore the projection of the dark ring, falling upon this shadow, will be invisible. This will be the case till October 18. It may also be much obscured if it should be projected on a dark belt; *and it seems very* probable that this may often have been the cause

of its having formerly been overlooked. It may even have been mistaken for a very narrow and unusually dark belt; or for a portion of one, the rest being concealed by the bright ring crossing the planet. The position of the ring subsequently to the beginning of last October, was especially favourable to its visibility; for it was projected on to the very bright region extending from the planet's centre towards its north pole, by contrast with which it would appear unusually dark."

On a Photometrical Method of Determining the Magnitudes of Telescopic Stars. By the Rev. W. R. Dawes.

"The magnitudes of telescopic stars are so variously assigned by different observers, as to render it impossible correctly to anticipate the appearance of such an object in a telescope of any particular kind and dimensions, without having reference to the scale of magnitudes adopted by the observer who has assigned the magnitude of the star in question; and even then it is necessary to suppose that his habit of estimating is fixed and tolerably uniform. The differences among observers of great experience and celebrity are much greater than would probably be imagined by those who have not been led to examine the subject, and clearly show that widely different *scales* of magnitude have been adopted; and though, provided each observer's habit of estimation is generally consistent with his own scale, it might not be very difficult to convert the magnitudes of one into those of another, yet the trouble of this is to be deprecated; and the different numerical denominations of the magnitude of the same star create complication and confusion where simplicity and uniformity are especially desirable.

" In examining the estimated magnitudes by different observers, one remarkable fact presents itself; namely, that there is a tendency common to almost all to underrate the magnitudes of stars when seen through a telescope. This is most strikingly exemplified by observations of stars visible with the naked eye, and whose magnitudes may therefore be estimated without telescopic aid. The following instances will afford illustrations of this:—

" ζ *Cancri.* This triple star is obvious to the naked eye, and is designated by Argelander, in his *Uranometria Nova*, as of magnitude 5·4 (or about 4·7). Telescopically its three components have been estimated thus: by Sir James South (S), 7, 8, 8; by Sir John Herschel (H), 8, 8½, 8½; by Struve (Σ), 5·0, 5·7, 5·5: the latter therefore agreeing with Argelander (A).

" 32 *Orionis.* Obvious to the naked eye, and designated by A as 5·6 (or about 5·3); by H, 7½ and 8½ (mean of two estimations); by Σ, 5·2 and 6·7, nearly agreeing with A.

" ζ *Aquarii.* A double star whose components are nearly equal, appearing to the naked eye as a bright 4 mag., and designated by

A as 3·4 (or about 3·3); by S, 7 and $7\frac{1}{4}$; by Σ, 4·0 and 4·1, agreeing therefore very nearly with A.

"δ *Serpentis.* A double star, to the naked eye a rather small 3 mag., and by A called 3·4 (= about 3·3). The components are called by Σ 3 and 4, making the star about half a magnitude brighter than A's estimation; while by S they are estimated on *five different nights* as 8 and 9,—being a difference of five magnitudes.

"γ *Virginis.* A well-known double star, whose components are equal; to the naked eye a bright third mag., or, according to A., 3·2 (= about 2·7). By S, estimated on three nights as 8 and $8\frac{1}{2}$, and on one night as $8\frac{1}{2}$ and 9,—being a difference of more than five magnitudes.

"α *Cancri,* by A's naked-eye estimation, is of mag. 4; by Bessel (B) it is telescopically estimated as of the 6th mag.

"κ *Cancri,* estimated with the naked eye by A as of the 5th; telescopically by B, as of the 7th.

"ν *Leonis,* by A's naked-eye estimation, = 5; by B telescopically, = 7.

"The above are a few of the many examples which might be cited from the works of some of the most practised observers. That such stars as δ *Serpentis* and γ *Virginis,* which would by the naked eye be instantly missed from the constellations to which they belong, should be deliberately and repeatedly designated by any practised observer as of magnitudes so small as to be less visible than the planet *Neptune,* is certainly surprising, and strikingly shows the effect occasionally produced on these estimations by the use of a telescope, and especially under high magnifying powers, and perhaps an illuminated field. And it appears that even Bessel has not unfrequently been deceived into estimating stars plainly visible to the naked eye as of only the 7th magnitude.

"It must be acknowledged, however, that it is not very easy for an observer to maintain consistency even with his own scale of telescopic magnitudes, especially under the varying aspects produced by different magnifying powers. And even if it were otherwise, and consistency were usually or easily preserved, the adoption of a different scale by each observer, depending perhaps upon the optical power of the instrument he happens to employ, is productive of great confusion, and requires at any rate that the name of the observer should be affixed to the magnitudes which he assigns, or that the scale he uses should be distinctly stated, in order that some idea may be conveyed of the kind of object we may expect to meet with under the given designation.

"I am not aware upon what principles the scales of telescopic magnitude employed by some of the observers of the most extensive catalogues have been formed. It is evident that Lalande, Piazzi, Bessel, and Argelander, have not referred their estimations to precisely the same standard; the two last, however, differing but slightly, as might be expected from their early association in the *Königsberg* zone observations. But the adoption of a particular

numerical magnitude to represent a certain degree of brightness has been, as far as I know, purely arbitrary. Even Struve, as we are informed by himself, was led to fix upon the twelfth magnitude to represent the smallest star usually visible in the Dorpat refractor, simply because the number of telescopic magnitudes would thus be the same as those customarily applied to the stars visible with the naked eye. (See Introduction to the *Mensuræ Micrometricæ*, p. lxvii.) Sir J. Herschel has carried his estimation of stars visible in his 20-foot front-view reflector down to the 20th magnitude; and Mr. Bond has done the same in respect to the Munich refractor having an aperture of 15 inches. Here also the limit of visibility appears to have been arbitrarily assigned. Sir J. Herschel has, however, given examples of the different units of his scale from the sixth downwards, in his *Introduction to the First Series of Double Stars* discovered in sweeping with his 20-foot reflector. (See *Memoirs of the Astronomical Society*, vol. ii. p. 464.) And in the Introduction to his Third Series, contained in vol. iii. p. 182, of the *Memoirs*, he says,—'The principle on which I have endeavoured to proceed, in estimating the relative magnitudes of stars below the sixth, is that of continually halving the light of each magnitude to give that of the next inferior denomination; so that, in fact, two stars of the 9th magnitude, so close together as not to be distinguished from one, shall affect the eye as a single star of the 8th,' &c.

"Professor Struve also informs us that he has adopted a somewhat similar plan in assigning the magnitudes of the two components of a double star; with this important variation, however, that a star having half the light of any given magnitude is considered to stand only *half* a magnitude lower in the scale; so that two stars of the 9th magnitude, when viewed with a power too low to separate them, shall affect the eye as one of magnitude $8\frac{1}{2}$; and if a star appearing to the naked eye as of the sixth magnitude were divided by the telescope into two equal stars, each of the components would be considered as of the magnitude $6\frac{1}{2}$; and so on. (See Introduction to the *Mensuræ Micrometricæ*, p. xlii., at the bottom.)

"Now it occurred to me, some years ago, that upon the same principle more completely and extensively carried out, the magnitudes of telescopic stars, or their quantity of light relatively to any given standard, might be pretty accurately determined by a photometrical process. It would certainly be convenient, for the sake of uniformity, that the ratio of light in any two given denominations of magnitude should be generally agreed upon, as the necessity for translating the language of one scale into that of another would be thereby avoided. In the case of the two scales just referred to, the Herschelian assigns a decrease of light according to the powers of $\frac{1}{2}$; while the Struvian assigns a decrease according to the powers of $\frac{3}{4}$; the units of numerical denomination increasing in arithmetical progression. The two scales therefore rapidly diverge, but are easily comparable; yet it would be more convenient if only one were employed.

"The photometrical method which I would now propose is founded on the obvious principle that if there be two stars, A and B, of which B possesses *half* the brightness of A, then will B require *twice* the telescopic illuminating power to render its image equally bright with that of A; and the requisite increase of illuminating power is produced by employing *twice the area* of the object-glass, or object-mirror, which has been found to give to the image of A a definite degree of brightness. Thus the area employed must be inversely as the brightness of the object; and consequently the reciprocal of the area requisite to impart to the image of a star a definite degree of brightness becomes a measure of the intrinsic brightness, or magnitude, of that star.

"In order to the practical application of the proposed method, it is necessary previously to fix upon the magnitude from which to set out, and with which others are to be compared as a standard. To avoid as far as possible the uncertainty attending the denomination of *telescopic* magnitudes, I propose to employ as the standard an average of stars of the *sixth* magnitude, according to Argelander's *Uranometria Nova*. This may be taken as the limit of steady visibility by the average of *unassisted* vision on ordinary clear nights; and this *limit of steady visibility* is the *definite degree of brightness* to which all objects must be brought up in comparing their magnitudes with the standard magnitude.

"The next point to be determined is the *telescopic aperture* requisite for rendering average stars of the sixth magnitude just steadily visible. From theory it might readily be concluded, that, as *both* eyes are employed in unassisted vision, and as also much light is lost by reflection at the eight surfaces presented by the double object-glass and double eyepiece of an achromatic telescope, to which, moreover, only *one* eye is applied, it would require an achromatic aperture considerably *larger* than the pupil of the eye to meet the proposed conditions, especially when a magnifying power is employed which is large, compared with an aperture whose diameter is only two or three tenths of an inch. But experiment proves that in this case, as in many others, some circumstances, with which perhaps we are but imperfectly acquainted, greatly modify the deductions to which theory would lead. My experiments have been conducted principally with the finder of my Munich equatoreal, having an aperture of 1·53 inch, a focal length of 20 inches, and a magnifying power of $16\frac{1}{2}$. Assuming that the pupil of my eye might probably be 0·2 of an inch in diameter, when stimulated by no more light than that of a clear moonless night, I employed an aperture of a quarter of an inch as making a fair allowance for the loss of light, the magnifying power, and the use of only one eye in observing. This aperture, however, proved to be much too large, stars of the sixth magnitude being far more than only just steadily visible with it. After various experiments, an aperture of 0·15 of an inch was fixed upon; and with this and the usual power of $16\frac{1}{2}$, a list of 21 sixth-magnitude stars from *Argelander's Uranometria Nova* were examined. Of these, 9 ap-

peared to be of precisely the standard brightness, being just steadily visible; 7 were rather too bright, and were estimated to be of magnitudes from one to five-tenths of a unit brighter than the sixth; while the remaining 5 were rather too faint, and were estimated at from 6·1 to $6\frac{1}{4}$. The mean of the whole gave $D = A - 0{\cdot}04$, or $6\ D = 6{\cdot}04\ A$. The average estimation may, therefore, be considered as identical.

"It is, however, obvious that the various degrees of sensibility of the optic nerve in different persons must render it necessary for each observer to determine experimentally for himself what aperture of the telescope he uses is requisite to give the desired visibility to average stars of the sixth magnitude; and from that to determine the apertures corresponding to the lower magnitudes. In all such cases the telescope and the observer's eye must be considered as constituting one compound optical instrument.

"It was at first my intention to adopt Sir J. Herschel's scale, as generally avoiding the use of half-magnitudes; but it immediately appeared that the magnitudes thus determined would be widely different from those adopted by the principal observers of extensive star-catalogues, especially Lalande, Piazzi, Bessel, and Argelander. I have, therefore, adopted Struve's ratio of progression, according to which, as will appear hereafter, the magnitudes assigned by the proposed method very nearly agree with the average estimations of the great observers just mentioned; and this I considered a sufficient reason for giving it the preference.

"Let, then, the numerical magnitudes of telescopic stars be assumed, so that one star of the sixth magnitude shall equal two stars of magnitude $6\frac{1}{2}$; and one star of magnitude $6\frac{1}{2}$ = two stars of magnitude 7, and so on. Then, putting m = the standard magnitude; a = the aperture necessary to show it; μ = any other inferior magnitude, expressed as usual by a larger numerical denomination; and α = the corresponding aperture necessary to render visible a star of the magnitude μ, we have $\alpha = a \,.\, 2^{\mu - m}$; by which formula the apertures in the following table, corresponding to the different magnitudes in the scale may be computed; 0·15 of an inch being the standard aperture corresponding to magnitude 6, *suited to my own eye.* I add also the corresponding apertures of reflecting telescopes of various constructions, the ratio of an equally illuminating aperture to the aperture of an achromatic refractor being assumed in the Herschelian, or front view, as 6 to 5; in the Newtonian, as 7 to 5; and in the Gregorian, as 8 to 5.

Σ's Magnit.	H's Magnit.	Achromat. Aperture.	Front View Aperture.	Newtonian Aperture.	Gregorian Aperture.
		inch.	inch.	inch.	inch.
6	6	0·15	0·18	0·21	0·24
$6\frac{1}{2}$	7	0·21	0·25	0·30	0·34
7	8	0·30	0·36	0·42	0·48
$7\frac{1}{2}$	9	0·42	0·51	0·60	0·68
8	10	0·60	0·72	0·85	0·96

Σ's Magnit.	H's Magnit.	Achromat. Aperture.	Front View Aperture.	Newtonian Aperture.	Gregorian. Aperture.
		inch.	inch.	inch.	inch.
8½	11	0·85	1·02	1·20	1·36
9	12	1·20	1·44	1·70	1·92
9½	13	1·70	2·04	2·40	2·72
10	14	2·40	2·88	3·39	3·84
10½	15	3·39	4·07	4·80	5·43
11	16	4·80	5·76	6·79	7·68
11½	17	6·79	8·15	9·60	10·86
12	18	9·60	11·52	13·58	15·36
12½	19	13·58	16·29	19·20	
13	20	19·20	23·04	27·15	
13½	21	27·15	32·58	38·40	
14	22	38·40	46·08	54·31	
14½	23	54·31	65·17	76·80	
15	24	76·80	92·16	108·61	

"In computing such a table, however, with any magnitude and corresponding aperture as the standard, the numbers may be more readily deduced from the standard aperture than by computing each by the formula. For the apertures suited to the succeeding units of magnitude below the sixth are deduced from the aperture suitable to the sixth, by continually multiplying by 2. The aperture adapted to the first half-magnitude below the sixth is obtained by multiplying the aperture for the sixth magnitude by the root of 2 (= 1·4142). And for the succeeding half-magnitudes the aperture thus found for magnitude 6½ is also continually multiplied by 2.

"As an example of the computation by the formula of the numbers expressing the achromatic apertures in the above table, let it be required to find the aperture (α) corresponding to the 12th magnitude in Struve's scale.

"Here $m = 6$; $a = 0{\cdot}15$; $\mu = 12$; $\mu - m = 6$; and $\alpha = a \,.\, 2^{\mu - m} = 0{\cdot}15 \times 2^6 = 9{\cdot}6$.

"It is very remarkable that the aperture thus determined to be requisite for rendering just visible to my own eye a star of Σ's 12th magnitude, should be precisely the aperture of the Dorpat refractor to which Struve has arbitrarily assigned that magnitude as the smallest visible on ordinary nights.

"Putting H = the numerical magnitude according to the Herschelian scale, and Σ = the numerical magnitude according to the Struvian scale, we have the formula, $H = 2\,\Sigma - 6$, by which the Struvian are converted into the Herschelian; and the formula, $\Sigma = \frac{H + 6}{2}$, by which the Herschelian are deducible from the Struvian.

"It must be acknowledged that the magnitudes actually

assigned by Sir John Herschel to double stars discovered in his sweeps, frequently differ considerably from those to which they are entitled according to the comparative scale in the above table. Yet from several circumstances I am led to attribute this difference mainly to the great difficulty, amounting almost to impossibility, of assigning the proper place in the scale to objects differing so greatly in brightness as do the stars within the compass of the front view 20-foot reflector; and especially when caught hastily during sweeps, the principal objects of which are of quite another character. In several remarkable instances, however, where, from some particular interest attaching to the object, the magnitudes have been carefully estimated, the agreement of the estimation with the numbers in the table is striking. As examples, we may cite some of the objects specially mentioned by Sir John in his *Introduction to his Third Series*, as probably not within the reach of the Dorpat refractor. (*Mem. Ast. Society*, vol. iii. p. 182.) Of these, M. Struve selected three for examination, viz. κ *Geminorum*, ξ *Pegasi*, and α^2 *Cancri*. Of κ *Geminorum* the small companion is stated by H to be of magnitude 14; Σ assigns to it magnitude 10. ξ *Pegasi* is of magnitude 5 and 18, according to H; of 5 and 12, according to Σ. In these two instances the estimation of brightness is *identical*; the numerical difference of magnitude being precisely what the two scales require. To α^2 *Cancri* H assigns $4\frac{1}{2}$ and 20; Σ does not give his magnitudes; but having measured both the position and distance with the Dorpat telescope, the magnitude he would assign is certainly not below the 12th, perhaps about $11\frac{1}{2}$, which would agree with 17 H. Subsequently, the companions both of ξ *Pegasi* and α^2 *Cancri* were stated by H to be of 16 mag. (See *List of Test Objects* in *Mem. Ast. Society*, vol. viii. p. 31.) And this shows the difficulty of rightly designating these *intensiva* of faintness, without some photometrical standard, to which from time to time recourse may readily be had; for, according to the Herschelian scale, one star of the 16th magnitude is equal to 16 stars of the 20th. To these may be added the faint companion of τ *Boötis*, to which H assigns 16 mag. By my method it appears to be of magnitude $11\frac{1}{4}$, which corresponds to $16\frac{1}{2}$ H. In the comparative table, however, drawn up by Sir John Herschel from about 500 comparisons of the magnitudes assigned by himself in his sweeps, and by Struve, in his large catalogue of double stars (*Mem. Ast. Society*, vol. iii. p. 180), the *average* difference is found to be only about one magnitude. So far, then, from the magnitudes of the smaller stars having been usually underrated by Sir John, the deviation from his own scale seems to have been decidedly in the opposite direction, and, as has been pointed out by himself, gradually increasing. (*Mem. Ast. Society*, vol. vi. p. 80.)

" Mr. Bond carries his numerical designation of the magnitudes of stars visible with the refractor of 15 inches in aperture, down to 20. His scale, therefore, appears so nearly to agree with the Herschelian that it may be deemed practically identical. For by the

formula, $\alpha = a \cdot 2^{\mu - m}$, we find, that when $m = 6$, $a = 0{\cdot}15$, and $\alpha = 15$, the value of $\mu = 12{\cdot}64$, which is the magnitude according to Struve's scale; and this converted into the Herschelian scale $= 19{\cdot}28$; sufficiently near to 20 to require no further correction.

"But it is especially a matter of interest to ascertain how far the magnitudes, photometrically determined by the plan now proposed, agree with those which have been employed by the observers of the most extensive star-catalogues. To this end I have examined a considerable number of objects taken from Baily's edition of the *Hist. Cél.* of Lalande, from Weisse's Bessel, and from Argelander's zone observations. My selected working catalogues contained only the right ascension and declination of the objects, without any intimation of their magnitudes, and were arranged in the order of right ascension. The proper apertures, adapted to the case where $m = 6$ and $a = 0^{\text{in}}{\cdot}15$, having been cut out of card-board and laid out on a table in the observatory, the equatoreal was set to the place of the object; an estimation made of its magnitude from its appearance in the finder, in the first place without diminution of its aperture; and then such a diminishing aperture selected by trial as reduced the brightness of the object to the lowest point compatible with keeping it steadily in view when the eye was directed fully upon it. The designation of the star, with the aperture suitable to it, and the corresponding magnitude, were immediately entered in my journal; and it appeared that the finding of each object, determining its magnitude, and recording the particulars, occupied from three to four minutes: so that from fifteen to twenty could be thus determined in an hour. The nights devoted to this work were invariably those whose quality was not suitable for micrometrical operations, though apparently free from any considerable quantity of haze.

"In the following table, the first column, under the initial D, contains the magnitude, as determined by the proposed method; in the second column is stated the whole number of stars of each magnitude which have been used in the comparisons. The third column, under the initial B, contains the average corresponding magnitude attributed by Bessel to the stars whose number is given in the fourth column; the fifth and sixth columns contain the corresponding magnitudes and the number of stars from Argelander; and the seventh and eighth columns contain similar quantities from Lalande. The ninth column contains the differences between the magnitudes assigned by me and the mean of the corresponding magnitudes from Bessel, Argelander, and Lalande; and the tenth column contains the results of comparison of my magnitudes with the mean of Bessel and Argelander only. The stars from Lalande are all included among those taken from Bessel and Argelander. The whole number of stars compared is 187; of which 92 are from Bessel, and 95 from Argelander; and 81 are also found in Lalande.

D.	Stars.	B.	Stars.	A.	Stars.	L.	Stars.	$D-\frac{B+A+L}{3}$	$D-\frac{B+A}{2}$
7·0	19	7·00	12	6·97	7	6·53	15	+0·17	+0·01
7·5	30	7·47	16	7·44	14	7·47	23	+0·04	+0·05
8·0	51	8·15	26	8·09	25	8·17	25	+0·14	−0·12
8·5	50	8·69	24	8·37	26	8·43	13	0·00	−0·03
9·0	37	8·99	14	8·86	23	8·70	5	+0·15	+0·08

"The only discrepancy of any consequence among the numbers in the table occurs in Lalande's estimations of stars which I have designated of the 7th magnitude. The difference amounts to nearly half a magnitude, and arises from the frequency with which Lalande has assigned the 6th magnitude to stars not contained in Argelander's *Uranometria*, and certainly not ordinarily visible to the naked eye. There is also a difference of 0·3 of a unit in the same column corresponding to my 9th magnitude; and the cause of this is found partly in Lalande's having more rarely used 9 as a designation of magnitude than either Bessel or Argelander has done; and partly, no doubt, in the small number of stars (only 5) of that magnitude found in Lalande among the stars compared.

"On the whole, the agreement of the magnitudes determined by the proposed method, with those employed by the three great zone observers, is far more close than I could have ventured to anticipate; and constitutes a strong additional recommendation of it on the ground of uniformity, so especially desirable in this department of practical astronomy.

"It has been supposed that the magnitudes assigned by Struve to the objects contained in his great Dorpat catalogue are usually much too high. Tested by my photometrical method, the average difference between his estimations and my own is rather more than one quarter of a magnitude, by which quantity his magnitudes are higher than mine. By comparison of 74 stars common to Struve and Bessel, between the sixth and ninth magnitudes, the mean difference results, $\Sigma = B - 0{\cdot}40$. And by 32 telescopic stars common to Struve and Argelander the average difference comes out, $\Sigma = A - 0{\cdot}46$; by which quantities, 0·40 and 0·46 respectively, Struve's magnitudes are higher than Bessel's and Argelander's. A comparison, however, of 80 stars in Argelander's *Uranometria*, from the 3d to the 6th magnitude, gives the mean difference in the estimations of those stars, $\Sigma = A - 0{\cdot}005$ only. From the moderate number of stars compared in the above cases, the conclusions can be received only as showing the tendency; yet so great is the consistency and uniformity of estimation by these eminent observers, that I doubt if the results would be greatly modified by a more extensive comparison. And they are sufficient to show that the proposed method of photometrical determination gives results holding a middle place among those of the most careful and accurate observers, and differing from any of them on an average by only a small fraction of a unit of the scale adopted.

"One great recommendation of the method of apertures for the

determination of magnitudes consists in the case with which it is employed; requiring no new instrument or eye-piece, or any variation in the arrangement of the telescope or its eye-pieces, which may be in use at the time. Nothing more is wanted than a few circular apertures neatly cut out of card-board, and of such a size as to be applied to the object-end of the finder, for the determination of magnitudes, as far as that instrument will extend. The only difficulty or inconvenience attends the application of various apertures to the object-end of large telescopes without disturbing the instrument. This, when the telescope is a refractor of considerable focal length, requires some special contrivance, which, however, is of a very simple character. If near the extremity of the dew-cap a small ledge or shoulder be made in the inside, the apertures corresponding to the magnitudes beyond the power of the finder may be easily raised to their place by a hook of suitable shape at the end of a light wand of sufficient length; and thus the telescope may remain unmoved from the object.

"The same effect which it is proposed to produce by the application of various apertures before the object-glass might be attained by the use of very small eye-holes; precisely the same phenomena occurring as when the aperture of the telescope is diminished at the object-end. It is obvious that when the eye-hole is less than the emergent pencil, its effect is to cut off part of the rays transmitted by the object-glass; and if the eye-hole be duly proportioned to the magnifying power employed, any required aperture may be taken into use and the rest excluded. But though this is a neat and handy mode of diminishing the aperture, there are two grave objections to its use. The first is the difficulty of making eye-holes of precisely the proper size for bringing into use a definite portion of the object-glass; and the second and still more serious objection is, that the same eye-hole will cut off different portions of the object-glass with different magnifying powers; and, consequently, it would always be necessary to employ the same magnifying power, or else to have various sets of eye-holes adapted to the powers usually employed. And thus a complication and difficulty would arise sufficient in most cases to prevent the use of the method altogether.

"I may here mention a plan by which I have succeeded in measuring pretty accurately the diameter of the pupil of my own eye when exposed to no other light than that of the stars. I am not aware that this has hitherto been done. An aperture of about 0·2 of an inch has been assigned to the pupil as probably near the truth on an average; though it no doubt varies considerably in different individuals: but I believe this is not founded on experiment, which indeed may seem to be rendered impossible by the absence of sufficient light. The method I employed is this. Being very short-sighted (requiring the use of Dollond's No. 9 concave), the image of a bright star on the retina of my eye is a luminous disk of large diameter. If a small hole in a card be held close to the eye, the diameter of this luminous disk will be diminished when

the hole is smaller than the pupil; but when the hole is precisely of the same size as the pupil, the whole of the disk will be included, provided the hole and the pupil are concentric; but the slightest movement of the hole in any direction will cut off a portion of the luminous disk on the opposite side, and change the circular disk into a gibbous one. With a little care the experiment may be made with great nicety; a difference of one or two hundredths of an inch in the size of the hole being immediately perceptible in the effect. By this means I have ascertained the pupil of my eye by starlight to be, as nearly as possible, one quarter of an inch. It is obvious that a person who is not short-sighted may try the same experiment by the use of a convex lens.

"It has occurred to me in the course of these experiments, that diminishing apertures applied to the naked eye might be employed in the determination of star-magnitudes higher than the sixth. It is evident that the scale I have adopted for the lower magnitudes will not apply to these. Calculated by the same formula, the aperture with which a star of the second magnitude should be visible is only the hundredth of an inch. This is much too small: yet with this aperture, *Sirius* is steadily visible, and appears with a planetary disk as if seen through a telescope with a high power in proportion to the aperture. On viewing the sun, and also the full moon, through this extremely small hole, a curious phenomenon presents itself. The edges of their disks are softly defined, and are surrounded by a well-formed bright ring, precisely similar to the first luminous ring round the disk of a bright star viewed with a fine telescope and high power. This is still seen when the hole is as large as the fortieth of an inch in diameter; and this agrees with the telescopic fact, that the emergent pencil must be reduced to about the same size before the ring round a star is separated from its disk. Of course, a moderately dark glass will be required for observing this phenomenon on the sun; and in all cases the edges of the hole should be clean and smooth.

"It might be supposed that in the determination of magnitudes by the use of various apertures on a telescope, the results would be perceptibly affected by the magnifying power employed. But experiment does not support this notion. The mere visibility of stars, even of the faintest, is but slightly affected by the power employed, provided always that the air is pure and the moon absent, or not within 40° or 50° of the object. Indeed, it is a fact that an increase of power brings out many small stars which were invisible with a lower magnifier. But this has its limits; and there is a certain ratio of illuminating and magnifying power which is both more pleasant to the eye and more efficient than any other. This I believe to be attained when the diameter of the emergent pencil is about 0·02 of an inch. Consequently, the power $16\frac{1}{2}$ on my finder is too great to be the most efficient for the apertures below 0·3 of an inch; and when the aperture is reduced to 0·15 of an inch, and the diameter of the emergent pencil is therefore only 0·009 of an inch, the appearance of a star of the sixth magnitude,

to which that aperture corresponds, resembles that of a faint planetary nebula. But this is quite consistent with the object being steadily seen when the eye rests upon it; just as a dull planet, such as *Saturn*, viewed with a telescope in full sunshine, may perhaps not be seen at all till the eye has for some time searched over the field of view; yet, after being caught sight of, it remains steadily visible when the eye is directed fully upon it. Generally, however, a lower power, as 8 or 10, might be more agreeable and less fatiguing to the eye when the aperture employed is less than 0·3 of an inch. And this may be especially desirable in determining the standard aperture for stars of the sixth magnitude, from which the apertures suitable to the inferior magnitudes are to be deduced.

"It is interesting and desirable to ascertain the magnitude of the smallest star visible in a telescope of any given size and construction; and this may readily be deduced from the formula. For since $\frac{\alpha}{a} = 2^{\mu - m}$, the value of μ for any given values of α and a may be found. Adapting the formula to logarithmic computation, we have $\mu = \frac{\log \alpha - \log a}{\log 2} + m$. If, for example, it be desired to know precisely what magnitude should be attributed to the *minimum visibile* in my $8\frac{1}{2}$-foot refractor, whose aperture is 6·34 inches; where, as in my own case, $a = 0{\cdot}15$ when $m = 6$, we have $\mu = \frac{0{\cdot}8021 - 9{\cdot}1761}{0{\cdot}3010} + 6 = 11{\cdot}34$, the magnitude sought, according to the Struvian scale. And since $H = 2\,\Sigma - 6$, the corresponding Herschelian magnitude $= 16{\cdot}68$. In like manner the *minimum visibile* in the finder of my equatoreal $= 9{\cdot}35$ $\Sigma = 12{\cdot}70$ H. And a star only visible by fits, or steadily visible only on extraordinarily brilliant nights, may be safely denominated of $9\frac{1}{2}$ magnitude.

"It is obvious that any numerical magnitude and its corresponding aperture suited to the ocular sensibility of any observer, may be made the standard; or may represent m and a respectively. And as the management of very small apertures on a telescope armed with a comparatively high power, is less easy than that of the larger apertures with the same power, it may be found by some observers more satisfactory to fix upon another magnitude (the 8th, for instance), as the standard, and to compute the numbers of their table of apertures from the aperture suitable to their eye for that magnitude. The formula I have given, being general, applies equally to this mode of proceeding; but for higher magnitudes than the standard value of m, whatever that may be assumed, the exponent of the power of 2 will be negative; the numerical value of μ being less than that of m. For this purpose, a list of stars whose magnitudes have been carefully determined, and conveniently situated for comparison at different times of the year, may form a desirable appendix to this communication, which I hope at some future time to do myself the pleasure of presenting to the *Society.*"

Extract of a Letter from Father A. Secchi, Director of the Observatory of the Collegio Romano.

"I have repeated M. Léon Foucault's experiment with a pendulum 31 metres long, and a weight of 28 kilograms; I have measured the angles with the greatest care, and have constantly found the deviation such as it should be according to theory. There is, however, a slight difference in the motion at the beginning and end of the series: at the beginning the angles are a few minutes in excess, and at the end a few minutes in defect. The errors, to be sure, are not larger than the probable errors of observation; but as they are constantly the same way, they seem to indicate a physical cause. They can have no effect to destroy this proof of the rotation of the earth. I have not completed the reduction of these observations; but the length and number of my series, some of which lasted six hours, leave no doubt at all as to the conclusion. I am surprised, therefore, to see that some English journals cast doubt on the correctness of this demonstration; but I presume these objections do not come from your men of science."

A Method of Delineating graphically M. Foucault's Pendulum-experiment demonstrative of the Earth's Diurnal Rotation. By J. Drew, Esq., *Phil. Doct.*, &c.

Mr. Drew conceives that the problem of the apparent rotation of the plane of a vibrating pendulum, with respect to the azimuthal plane at any point of the earth's surface, in consequence of the diurnal rotation, may be rendered clearer by the following graphical method of considering it:—

Draw the circle of latitude for the place at which the experiment is made, and imagine the cone enveloping the earth's surface at this circle to be also drawn. The apex of this cone will be in the earth's axis produced, and the length of its side will be the earth's radius × cot lat. of place.

Draw horary lines from the apex of the cone to the base or circle of latitude; then, if the sheet of the cone be imagined to be developed into a plane, the successive angles formed by the radial or horary lines with the initial radius representing the initial plane of vibration will represent the corresponding angles of revolution of the pendulum with respect to the azimuthal plane.

Now, the first of these angles,

$$= \frac{\text{subtending arc}}{\text{length of side of cone}}$$

$$= \frac{\text{equatoreal arc} \times \text{cos. lat.}}{\text{rad.} \times \text{cot. lat.}}$$

$$= 15^\circ \times \text{sin. lat.}$$

This, then, neglecting the small quantities that enter into the

rigorous solution of the problem, is the angle described by the plane of the pendulum in one hour of the earth's rotation, and Mr. Drew proposes to mark off angles equal to this through the whole circumference of the circle formed by the developed cone, and to draw lines through the points of the circumference thus formed parallel to that radius which represents the initial plane of vibration. If the cone be then made to envelope the sphere again, the lines thus drawn will represent to the eye the directions in which the pendulum will be swinging at each successive hour of departure from the initial plane during a whole day.

In the course of the evening, Mr. Sheepshanks gave a hurried account of the methods which he had adopted for graduating standard thermometers. Professor Piazzi Smyth made some remarks on reflecting instruments, with suggestions for their improvement. The substance of these lectures will probably form part of a supplementary *Notice*. This *Notice* will contain two other papers. These have been postponed from the present Number, *as they would have doubled the postage.*

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ROYAL ASTRONOMICAL SOCIETY.

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Astronomische Nachrichten.

Another blunder has been committed by the Post-office clerks, who charged postage, as for a letter, on the wrapper of vol. 32, *because it was on blue paper!* This mistake was immediately corrected by the higher authorities, who directed the extra postage to be returned, on exhibition of the cross bands. Dr. Petersen has now caused the title to be printed on the cover, so that it is hoped all will go on smoothly for the future. If the carelessness or ignorance of the subordinates at the Post-office cause any further hindrance, application will be made for the removal of the offending party. It is not to be endured that the liberal intentions of the Government should be thwarted by such agents.

Recently published, price 24*s.*, *General-Register der Bände* I. bis xx., *der Astronomischen Nachrichten*, ausgearbeitet von G. A. Jahn, Phil. Doct., &c.

In a letter dated Nov. 3, Mr. Lassell announces the discovery of two interior satellites of *Uranus*.

Discovery of a new Planet, by Dr. A. de Gasparis.

This planet, which is estimated by Dr. de Gasparis as of a fair 9th magnitude, was discovered by him on July 29. It has received the name of *Eunomia*.

EUNOMIA.

Naples. (Dr. A. de Gasparis.)

1851.	Naples M.T. h m s	App. R.A. h m s	App. Dec. ° ′ ″
July 29	11 44 53·7	18 15 59·94	−26 3 54·0
30	10 17 59·9	15 22·17	25 59 49·1
31	10 52 57·0	14 41·26	55 1·8
Aug. 2	11 17 37·9	13 26·89	46 26·1
3	9 31 4·2	12 53·98	41 57·4
4	12 9 18·0	12 18·25	37 3·9
5	11 54 22·6	11 47·17	32 31·2
8	11 40 32·5	10 25·09	19 30·9
9	10 11 23·3	10 2·93	15 13·9
10	10 2 50·1	9 41·03	10 46·0
11	9 11 24·7	9 21·72	6 31·1
12	10 20 28·5	18 9 1·79	−25 2 10·8

PADOVA. (M. Trattenero.)

1851.	Padova M.T. h m s	App. R.A. h m s	App. Dec. ° ′ ″	
Aug. 13	9 46 55·8	18 8 46·90	−24 58 19·2	4 Comparisons.
14	10 7 19·5	8 31·77	53 41·9	3 —
15	8 33 50·6	8 18·53	49 37·7	Meridian.
16	29 43·7	8 7·36	45 20·6	—
17	25 37·4	7 57·11	41 5·5	—
20	13 32·6	7 39·91	28 27·3	—
21	9 34·6	7 37·83	24 17·9	—
22	5 37·9	7 36·96	20 2·0	—
23	8 1 42·9	7 37·86	16 6·1	—
24	7 57 50·5	18 7 41·42	−24 12 3·3	—

HAMBURG. (M. C. Rümker.)

1851.	Hamburg M.T. h m s	App. R.A. ° ′ ″	App. Decl. ° ′ ″
Aug. 14	9 30 48·0	272 7 57·4	−24 52 47·3
19	9 10 30·6	271 55 50·8	24 32 46·5
28	8 25 43·9	272 2 57·0	23 56 3·5
29	8 37 24·7	5 59·0	51 55·7
30	9 5 32·2	9 22·9	47 57·9
31	8 29 41·5	13 13·5	44 14·3
Sept. 6	8 7 17·8	44 49·3	21 42·0
8	8 25 26·3	272 58 41·5	14 17·2
9	8 2 2·0	273 6 0·0	23 10 50·2
18	8 23 3·9	274 30 8·7	22 39 7·0
22	7 35 6·9	275 15 51·6	25 22·3
24	7 50 16·2	41 25·8	18 12·6
25	7 18 3·4	275 53 53·4	15 16·2
27	7 50 3·1	276 21 21·9	−22 8 16·1

The first two observations are corrected for parallax, those which follow are not corrected.

Mean Places for Jan. 0, 1851, of Stars in the path of *Eunomia*, by M. C. Rümker.

	Mag.	R.A. h m s	Decl. ° ′ ″		Mag.	R.A. h m s	Decl. ° ′ ″
(1)	9	18 0 31·73	−24 44 7·2	(7)	9	18 5 26·10	−24 36 6·8
(2)	9	2 32·86	28 39·8	(8)	9	5 27·50	45 6·5
(3)	9	3 37·29	40 18·0	(9)	10	5 51·06	32 36·1
(4)	9	3 39·06	30 55·1	(10)	10	6 51·22	34 42·0
(5)	8·9	4 25·01	37 34·4	(11)	6	18 12 21·07	−24 58 34·8
(6)	11	18 4 45·43	−24 42 5·0				

(1), (5), (7) have been determined by the meridian circle, the others by the equatoreal; (10) is rather doubtful.

Rome. (Professor Secchi.)

1851.	Rome M.T. h m s	App. R.A. h m s	App. Dec. ° ′ ″	
Aug. 6	9 12 16·5	18 11 21·34	−25 28 58·4	Merid. Circle.
7	7 53·4	10 54·03	24 32·1	— —
8	9 3 31·9	10 28·38	20 4·5	— —
9	8 59 12·4	10 4·70	15 39·7	— —
10	54 54·2	9 42·37	11 14·2	— —
11	50 37·9	9 21·94	6 56·1::	— —
12	8 46 23·4	18 9 3·23	−25 2 53·1	— —

MBRIDGE. Mer. Circle and Northumberland Equat. (Prof. Challis.)

Greenwich M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	No. of Comps. in R.A.	N.P.D.	Star.
9 51 51·7	18 8 17·68	+8·182	114 49 10·0	−9·9808	3	3	*a*
8 17 1·8	7 44·50		32 28·2	9·9871	Meridian.		
9 36 39·2	43·63	8·185	32 10·0	9·9800	8	3	*a*
8 13 1·0	7 39·58				Meridian.		
8 9 3·3			24 4·5	9·9868	Meridian.		
10 8 37·3	7 37·65	8·351	23 38·1	9·9713	6	6	*a*
8 5 6·9	7 37·26		20 0·0	9·9867	Meridian.		
9 18 5·5	37·23	8·149	19 42·7	9·9809	2	2	*b* & *c* equally
9 43 48·1	7 38·61	8·290	15 36·5	9·9751	3	3	*b*
9 43 51·3	38·69	8·290	114 15 37·1	9·9751	2	2	*c*
9 48 19·4	8 12·44	8·370	113 55 25·7	9·9690	4	4	*d*
10 25 40·3	9 51·67	8·510	32 9·8	9·9494	2	2	*d*
8 52 17·2	18 12 26·03	+8·325	113 10 38·8	−9·9712	10	6	*e*

Assumed *Mean* Places of the Stars, 1851·0.

	R.A. h m s	N.P.D. ° ′ ″	Name of Star.
a	18 12 21·01	114 58 33·9	B.A.C. 6217
b	17 53 43·34	114 16 33·4	7 Sagittarii = B.A.C. 6097
c	17 56 2·36	114 24 2·2	B.A.C. 6111
d	18 7 28·14	113 56 31·9	H.C. 33516
e	18 13 1·11	112 59 3·6	B.A.C. 6222

The places of the stars in the respective catalogues have been adopted, with the exception of those of B.A.C. 6217 and B.A.C. 6222, which were not to be depended on as being deduced from Lacaille alone. The assumed place of 6217 was determined by four transit and four circle observations taken at the Cambridge Observatory. The N.P.D. of 6222 was obtained by two circle observations, and its R.A. by two equatoreal comparisons with each of the stars B.A.C. 6286 and B.A.C. 6343. The seconds of the R.A. of B.A.C. 6286 in the catalogue should be 22·57 instead of 20·46, a wrong value of the annual variation having been used to derive it from the Cambridge Observations of 1834.

Durham. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1851.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	No. of Comps. in R.A.	N.P.D.	Set.
Sept. 12	8 9 0·0	18 14 4·27	+8·172	112 59 54·6	−9·9820	4	4	1
13	8 12 33·8	14 40·23	8·158	56 21·9	9·9824	24	8	2
15	8 25 0·1	15 57·82	8·245	49 31·2	9·9791	24	8	3
21	8 20 27·4	18 20 18·30	+8·301	112 28 33·8	−9·9757	21	7	4

P is the equatoreal horizontal parallax in seconds of arc; p and q are the required corrections in time and arc respectively.

Mean Places of Stars of Comparison, 1851·0.

Name.	R.A. h m s	N.P.D. ° ′ ″	Set.
Lalande, H.C. 33885	18 16 6·25	113 3 14·3	1, 2
B.A.C. 6222	13 1·92	112 59 14·9	3
Lalande, H.C. 34222	18 23 31·37	112 23 38·5	4

Bessel's precessions for the mean year have been applied to Lalande's stars, and not those given in the reduction by Baily.

Elements.

I. Professor Encke.*

	° ′ ″	
M	172 10 21·6	1851, Aug. 5, 0h Berlin M.T.
π	112 18 15·6	
☊	292 51 1·8	
i	13 0 18·5	
ϕ	7 50 44·2	
Log a	0·380110	
μ	954″·645	

II. MM. Westphal and Klinkerfues, of Göttingen, from the Naples Observations of July 29, August 5, and August 12.

	° ′ ″	
M	170 40 26·5	1851, Aug. 5, 0h Berlin M.T.
π	113 25 14·5	True Equinox, August 5.
☊	292 48 47·9	
i	13 3 5·8	
Log a	0·3803271	
Log e	9·1391746	
Log μ	2·9795160	

* These elements are calculated on the Naples Observations to August 12, which they represent very fairly: the Professor also calculated an approximate *ephemeris for the* immediate use of observers, which is omitted.

III. Signore Trattenero, of Padova, from the Naples Observations of July 29, Aug. 10, and the Padova Observation of Aug. 21.

	° ′ ″	
M	240 36 39·9	1851, July 30, 0h Green. M.T.
ϖ	56 23 14·4	Mean Equinox, July 30.
☊	293 42 6·3	
i	12 1 34·2	
φ	7 13 54·3	
Log a	0·393714	
μ	910″·82	

IV. By Mr. G. Rümker, from the Naples Observation of July 29 and the Hamburg Observations of Aug. 29 and Sept. 27.

	° ′ ″	
M	293 49 51·49	Oct. 1, 0h G. M. T. 1851.
ϖ	27 35 37·57	M. Eq. Jan. 0, 1851.
☊	293 52 54·76	
i	11 43 42·75	
φ	10 51 34·29	
e	0·1884017	
Log a	0·4228496	
Log μ	2·9157322	

These elements represent the middle observations, thus:—

Computation—Observation = { −0″·07 in Longitude. 0·00 in Latitude.

Ephemeris.

Computed from the above Elements by M. G. Rümker.

For 9d 36m Greenwich M. Time.

1851.	R.A. h m s	Decl. ° ′	Log Δ.	1851.	R.A. h m s	Decl. ° ′	Log Δ.
ct. 1	18 29 22	−21 53·9	0·37080	Oct. 16	18 46 21	−20 59·9	
2	30 23	50·5		17	47 36	56·1	0·40207
3	31 25	47·0		18	48 53	52·3	
4	32 28	43·5		19	50 10	48·3	
5	33 32	40·0	0·37893	20	51 28	44·4	
6	34 37	36·5		21	52 47	40·4	0·40935
7	35 43	32·9		22	54 6	36·4	
8	36 50	29·4		23	55 27	32·2	
9	37 57	25·8	0·38684	24	56 49	28·1	
10	39 6	22·2		25	58 11	24·0	0·41637
11	40 16	18·5		26	18 59 34	19·8	
12	41 27	14·9		27	19 0 58	15·6	
13	42 39	11·1	0·39456	28	2 22	11·3	
14	43 52	7·4		29	3 47	7·0	0·42314
ct. 15	18 45 6	−21 3·6		Oct. 30	19 5 13	−20 2·5	

1851.	R.A. h m s	Decl. ° ′	Log Δ.	1851.	R.A. h m s	Decl. ° ′	Log Δ.
Oct. 31	19 6 40	−19 58·1		Nov. 20	19 37 35	−18 16·1	
Nov. 1	8 7	53·6		21	39 13	10·2	
2	9 34	49·1	0·42968	22	40 53	−18 4·3	0·45844
3	11 3	44·5		23	42 32	−17 58·3	
4	12 32	39·8		24	44 12	52·2	
5	14 2	35·1		25	45 52	46·2	
6	15 32	30·3	0·43595	26	47 32	40·0	0·46340
7	17 3	25·5		27	49 13	33·8	
8	18 35	20·5		28	50 54	27·5	
9	20 7	15·5		29	52 35	21·0	
10	21 40	10·5	0·44197	30	54 17	14·5	0·46811
11	23 14	5·3		Dec. 1	56 0	7·9	
12	24 48	−19 0·1		2	57 43	−17 1·2	
13	26 22	−18 54·9		3	19 59 26	−16 54·4	
14	27 57	49·6	0·44771	4	20 1 9	47·5	0·47256
15	29 32	44·2		5	2 52	40·6	
16	31 7	38·7		6	4 36	33·6	
17	32 44	33·2		7	6 21	26·5	
18	34 21	27·5	0·45320	8	20 8 6	−16 19·4	0·47675
Nov. 19	19 35 58	−18 21·8					

Earlier Elements and Ephemerides by M. G. Rümker are omitted.

IRENE.

Liverpool. Equatoreal. (Mr. Hartnup.)

1851.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	Star of Comp.
Aug. 1	9 57 7·6	15 40 41·53	+8·439	108 15 22·2	−9·9543	B.A.C. 5176
	10 13 7·5	41·71	+8·472	25·7	−9·9486	— —

The following is the assumed *mean* place of the star of comparison for 1851·0, derived from the Greenwich 12-year Catalogue:—

	R.A. h m s	N.P.D. ° ′ ″
B.A.C. 5176	15 33 22·20	109 11 30·54

Hamburg. (M. Rümker.)

1851.	Hamburg M.T. h m s	App. R.A. ° ′ ″	App. Dec. ° ′ ″
July 22	10 41 5·0	233 53 20·0	−17 18 43·2
24	10 30 29·0	234 5 47·6	−17 29 44·5

Not corrected for parallax.

Mean Places for January 0·1851 of the two Stars with which the Planet was compared both days.

R.A. h m s	Dec. ° ′ ″
15 38 49·37	−17 37 17·3
15 41 20·75	−17 26 32·4

AMBRIDGE. Northumberland Equatoreal. (Prof. Challis.)

Greenwich M.T.	App. R.A.	Log $\frac{p}{P}$	App. N.P.D.	Log $\frac{q}{P}$	No. of Comps. in R.A.	No. of Comps. in N.P.D.	Star.
h m s	h m s		° ′ ″				
11 0 5·2	16 2 15·06	−8·076			5		*a*
12 17 58·3	11·92	+7·353	103 26 28·6	−9·9579	9	9	*a*
10 39 0·7	15 33 11·74	8·284	105 36 28·3	9·9566	6	6	*b*
10 55 49·4	32 55·07	8·367	105 45 54·2	9·9527	8	8	*b*
11 10 7·1	32 47·97	8·461	106 15 3·3	9·9452	2	2	*c*
11 3 59·5	32 59·06	8·465	25 18·8	9·9452	5	5	*c*
10 26 38·0	33 41·89	8·415	45 53·5	9·9512	1	1	*d*
10 38 18·1	41·65	8·443	65·9	9·9485	6	6	*c*
10 19 9·9	35 10·79	8·442	107 13 6·9	9·9496	3	2	*e*
10 0 38·0	38 53·24	8·463	107 57 58·2	9·9484	2	2	*f*
9 1 52·1	49 47·09	8·444	109 25 27·5	9·9536	3	3	*g*
9 21 3·2	47·43	8·484	33·3	9·9481	3	3	*h*
9 3 25·1	57 25·37	8·498	110 12 24·0	9·9469	9	9	*i*
8 52 57·7	15 59 30·00	8·490	110 24 2·4	9·9487	6	6	*k*
7 58 40·8	16 21 1·96	8·485	112 4 25·5	9·9521	3	1	*l*
7 49 14·3	22 20·86	8·471	9 40·7	9·9545	2	1	*l*
7 56 11·7	21·67	8·485	50·4	9·9522	2	1	*m*
7 30 11·7	25 1·57	8·441	20 11·0	9·9591	1	1	*l*
7 51 53·1	3·01	8·488	19·1	9·9521	9	5	*m*
7 41 39·1	27 47·12	8·478	30 33·9	9·9540	9	5	*m*
7 32 19·7	30 33·64	8·470	40 53·8	9·9555	10	5	*m*
7 18 35·7	33 23·46	8·451	50 36·4	9·9585	4	2	*m*
7 31 18·9	24·82	8·479	39·2	9·9544	6	4	*n*
7 24 16·7	16 34 50·31	+8·470	112 55 34·9	−9·9559	8	5	*n*

Assumed *Mean* Places of the Stars, 1851·0.

	Mean R.A.	Mean N.P.D.	Name of Star.
	h m s	° ′ ″	
a	16 2 43·20	103 35 54·2	Bessel (Weisse) xvi. 38
b	15 34 23·62	105 31 57·5	B.A.C. 5184
c	35 30·12	106 23 32·3	H.C. 28617
d	28 10·80	106 30 45·9	— 28389
e	30 13·50	107 10 12·2	— 28453
f	41 31·41	107 40 49·0	— 28786
g	54 28·20	109 25 12·7	— 29156,8
h	44 41·60	109 43 1·9	λ Libræ = B.A.C. 5251
i	58 6·01	110 15 37·4	ω^1 Scorpii = B.A.C. 5337
k	58 40·45	110 27 39·0	ω^2 Scorpii = B.A.C. 5342
l	16 15 32·46	112 17 57·8	H.C. 29826
m	29 24·35	112 35 3·7	— 30207
n	16 32 15·95	113 1 45·0	— 30295

"These mean places have been derived from the respective catalogues named bove. The right ascension of H.C. 29826 having been found to be about 3^s in rror, the assumed value has been deduced from the *Histoire Céleste* on the supposition that the star was observed at the *third* wire."

CAMBRIDGE. On the Meridian. (Prof. Challis.)

1851.	Green. M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	Log $\frac{q}{p}$
May 21	12 5 41·8	16 2 11·99	103 26 28·5	−9·9580
22	12 0 46·3	16 1 12·18	28 1·8	9·9581
26	11 41 4·0	15 57 12·90	35 14·2	9·9585
28	31 14·9	55 15·31	39 14·5	9·9587
31	16 35·1	52 22·77	45 38·8	9·9591
June 2	11 6 52·1	50 31·22	103 50 24·3	9·9594
4	10 57 12·9	48 43·54	....	......
16	10 0 56·5	39 36·64	104 31 30·1	9·9617
17	9 56 24·1	39 0·04	34 59·2	9·9619
19	47 24·9	37 52·50	42 13·7	9·9623
21	9 38 31·4	15 36 50·61	104 49 45·9	−9·9627

Elements.

Computed by Mr. G. Rümker, from the observation made at London May 19, a mean of the Berlin and Cambridge observations July 21, and the Cambridge observation Sept. 20.

	° ′ ″	
M............	74 35 20·56	1851, Sept. 20·0, Berlin M.T.
π............	178 42 34·87	Mean Equinox,
☊............	86 50 23·98	Jan. 0, 1852.
i............	9 6 14·49	
φ............	9 43 37·83	
Log e	9·2277759	
Log a	0·4123316	
Log μ	2·9315092	

These elements represent the middle observation, thus :—

Calculation — Observation −0″·04 in longitude.

— — +0·02 in latitude.

Ephemeris.

By MM. G. Rümker and O. Frömmeling.

For $9^h\ 36^m$ Berlin Mean Time.

1851.	R.A. h m s	Decl. ° ′	Log Δ.	1851.	R.A. h m s	Decl. ° ′	Log Δ
Sept. 1	16 9 44	−21 15·7		Sept. 10	16 21 8	−22 5·1	
2	10 57	21·3		11	22 28	10·4	0·400
3	12 11	26·9	0·37794	12	23 49	15·7	
4	13 25	32·5		13	25 11	20·9	
5	14 40	38·0		14	26 33	26·0	
6	15 56	43·5		15	27 56	31·1	0·409
7	17 13	48·9	0·39018	16	29 19	36·2	
8	18 31	54·3		17	30 43	41·2	
Sept. 9	*16 19 49*	−21 59·7		Sept. 18	16 32 8	−22 46·2	

1851.	R.A. h m s	Decl. ° ′	Log Δ.	1851.	R.A. h m s	Decl. ° ′	Log Δ.
pt. 19	16 33 34	−22 51·2	0·41927	Oct. 12	17 9 9	−24 29·7	
20	35 0	−22 56·1		13	10 48	33·3	0·46985
21	36 27	−23 0·9		14	12 28	36·7	
22	37 54	5·7		15	14 8	40·1	
23	39 22	10·5	0·42841	16	15 48	43·4	
24	40 51	15·2		17	17 29	46·7	0·47727
25	42 21	19·8		18	19 10	49·9	
26	43 51	24·4		19	20 52	53·0	
27	45 22	29·0	0·43726	20	22 35	56·1	
28	46 54	33·5		21	24 17	−24 59·0	0·48441
29	48 26	37·9		22	26 0	−25 1·8	
30	49 58	44·2		23	27 43	4·6	
ct. 1	51 31	46·5	0·44584	24	29 26	7·4	
2	53 4	50·8		25	31 10	10·0	0·49127
3	54 38	55·0		26	32 55	12·5	
4	56 13	−23 59·1		27	34 40	15·0	
5	57 48	−24 3·2	0·45414	28	36 25	17·4	
6	16 59 24	7·2		29	38 10	19·7	0·49785
7	17 1 0	11·1		30	39 56	21·9	
8	2 37	14·9		31	41 42	24·0	
9	4 14	18·7	0·46214	Nov. 1	43 28	26·1	
10	5 52	22·4		2	17 45 15	−25 28·2	0·50417
ct. 11	17 7 30	−24 26·1					

PARTHENOPE.

AMBRIDGE. Northumberland Equatoreal. (Prof. Challis.)

l.	Greenwich M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	No. of Comps. in R.A.	No. of Comps. in N.P.D.	Star.
21	13 26 5·6	1 50 48·87	−8·579	83 13 5·2	−9·8765	3	3	*a*
29	12 29 25·0	1 59 15·56	8·601	82 47 9·1	9·8812	4	4	*b*
7	12 4 38·6	2 7 23·97	8·600	27 47·7	9·8801	8	8	*c*
19	11 30 52·4	15 35·33	8·597	20 22·4	9·8787	7	4	*d*
23	11 26 48·5	17 32·71	8·586	22 35·6	9·8833	6	2	*d*
30	11 36 5·9	2 19 54·38	−8·563	82 32 14·4	−9·8710	8	6	*e*

Assumed *Mean* Places of the Stars, 1851·0.

	R.A. h m s	N.P.D. ° ′ ″	Name of Star. h
a	1 45 48·99	83 6 5·4	Bessel (Weisse) i, 823
b	1 58 20·67	82 27 59·0	— — i, 1040
c	2 3 29·54	82 7 47·4	64 Ceti = B.A.C. 672
d	2 13 16·56	82 17 49·6	Bessel (Weisse) ii, 206
e	2 21 4·97	82 17 25·4	— — ii, 347

These places were derived from the respective catalogues.

HAMBURG. (M. Rümker.)

1851.	Hamburg M.T. h m s	App. R.A. ° ′ ″	App. Dec. ° ′ ″	
July 24	12 30 22·7	28 30 43·2	+6 57 45·2	
27	14 31 31·7	29 19 24·5	+7 7 16·1	
30	12 31 42·1	30 3 22·0	15 20·8	
Aug. 2	12 52 9·7	30 45 56·4	22 51·8	Correct.
4	12 30 26·7	31 12 45·5	27 1·1	
5	12 37 57·0	31 25 52·2	+7 28 57·9	

Not corrected for parallax.

Elements, No. IV.

Calculated by M. R. Luther.

Epoch 1851, October 22 0^h, Mean Time, Berlin.

	° ′ ″	
M	60 46 39·76	
ϖ	317 4 47·96	Mean Eq. 1851, Jan. 0.
☊	124 58 56·87	
i	4 36 53·48	
φ	5 37 4·32	
μ	926″·22181	

Ephemeris.

By MM. R. Luther and E. Vogel, of Berlin.

For 0^h Berlin M.T.

1851.	R.A. h m s	Decl. ° ′ ″	Log Δ.	Time of Aberr. in parts of a Day.
Aug. 24	2 17 48·68	+7 37 28·0	0·221828	0·00951
25	18 13·37	36 28·3	·219301	946
26	18 36·41	35 19·2	·216781	940
27	18 57·79	34 0·9	·214270	935
28	19 17·49	32 33·3	·211768	929
29	19 35·49	30 56·7	·209277	924
30	19 51·80	29 11·0	·206798	919
31	20 6·39	27 16·2	·204333	914
Sept. 1	20 19·24	25 12·4	·201883	909
2	20 30·32	22 59·5	·199449	903
3	20 39·64	20 37·6	·197033	898
4	20 47·21	18 7·0	·194635	893
5	20 53·01	15 27·6	·192256	889
6	20 57·02	12 39·5	·189900	884
7	20 59·24	9 42·7	·187566	879
8	20 59·67	6 37·4	·185256	874
Sept. 9	2 20 58·29	+7 3 23·6	0·182973	0·00870

1851.		R.A. h m s	Decl. ° ′ ″	Log Δ.	Time of Aberr. in parts of a Day.
Sept.	10	2 20 55·09	+7 0 1·2	0·180717	0·00865
	11	20 50·07	6 56 30·6	·178491	861
	12	20 43·23	52 51·7	·176295	857
	13	20 34·56	49 4·7	·174132	852
	14	20 24·07	45 9·8	·172002	848
	15	20 11·77	41 7·1	·169908	844
	16	19 57·64	36 56·7	·167851	840
	17	19 41·69	32 38·8	·165834	836
	18	19 23·94	28 13·4	·163858	832
	19	19 4·38	23 41·0	·161926	829
	20	18 43·03	19 1·5	·160038	825
	21	18 19·91	14 15·4	·158199	822
	22	17 55·03	9 22·6	·156410	818
	23	17 28·41	6 4 23·6	·154672	815
	24	17 0·10	5 59 18·7	·152986	812
	25	16 30·11	54 8·0	·151356	809
	26	15 58·49	48 51·9	·149784	806
	27	15 25·25	43 30·7	·148270	803
	28	14 50·45	38 4·7	·146816	800
	29	14 14·10	32 34·5	·145425	798
	30	13 36·27	27 0·2	·144099	795
Oct.	1	12 56·99	21 22·4	·142839	793
	2	12 16·30	15 41·3	·141646	791
	3	11 34·28	9 57·3	·140523	789
	4	10 50·97	5 4 10·7	·139472	787
	5	10 6·41	4 58 22·2	·138493	785
	6	9 20·67	52 31·9	·137588	783
	7	8 33·81	46 40·6	·136757	782
	8	7 45·89	40 48·4	·136002	781
	9	6 56·95	34 55·7	·135325	779
	10	6 7·07	29 3·2	·134725	778
	11	5 16·31	23 11·1	·134205	777
	12	4 24·71	17 20·0	·133767	777
	13	3 32·35	11 30·3	·133410	776
	14	2 39·31	4 5 42·3	·133136	776
	15	1 45·65	3 59 56·6	·132944	775
	16	2 0 51·45	54 13·5	·132836	775
	17	1 59 56·78	48 33·6	·132813	775
	18	59 1·73	42 57·4	·132875	775
	19	58 6·36	37 25·3	·133021	775
	20	57 10·76	31 57·9	·133253	776
	21	56 15·01	26 35·4	·133570	776
Oct.	22	1 55 19·19	+3 21 18·5	0·133973	0·00777

1851.		R.A. h m s	Decl. ° ′ ″	Log Δ.	Time of Aberr. in parts of a Day.
Oct.	23	1 54 23·35	+3 16 7·5	0·134461	0·00778
	24	53 27·59	11 2·7	·135036	779
	25	52 32·00	6 4·9	·135696	780
	26	51 36·65	3 1 14·2	·136440	781
	27	50 41·61	2 56 31·3	·137268	783
	28	49 46·99	51 56·5	·138179	785
	29	48 52·85	47 30·1	·139171	786
	30	47 59·27	43 12·6	·140244	788
	31	47 6·33	39 4·2	·141397	790
Nov.	1	46 14·08	35 5·3	·142629	793
	2	45 22·60	31 15·9	·143938	795
	3	44 31·94	27 36·7	·145322	798
	4	43 42·17	24 7·8	·146781	800
	5	42 53·35	20 49·3	·148312	803
	6	42 5·54	17 41·7	·149915	806
	7	41 18·79	14 45·1	·151588	809
	8	40 33·15	11 59·5	·153328	812
	9	39 48·68	9 25·2	·155134	816
	10	39 5·42	7 2·3	·157005	819
	11	38 23·42	4 51·0	·158938	823
	12	37 42·72	2 51·4	·160934	827
	13	37 3·36	2 1 3·3	·162989	831
	14	36 25·38	1 59 27·2	·165102	835
	15	35 48·81	58 2·9	·167270	839
	16	35 13·69	56 50·7	·169493	843
	17	34 40·05	55 50·5	·171768	848
	18	34 7·93	55 2·3	·174093	852
	19	33 37·35	54 26·2	·176467	857
	20	33 8·35	54 2·2	·178887	862
	21	32 40·95	53 50·1	·181352	867
	22	32 15·16	53 50·2	·183859	872
	23	31 51·02	54 2·4	·186407	877
	24	31 28·53	54 26·6	·188994	882
	25	31 7·73	55 2·8	·191617	887
	26	30 48·60	55 50·9	·194275	893
	27	30 31·18	56 50·8	·196966	898
	28	30 15·45	58 2·2	·199688	904
	29	30 1·45	1 59 25·2	·202439	910
	30	29 49·15	2 0 59·5	·205218	916
Dec.	1	29 38·57	2 45·0	·208023	922
	2	29 29·70	4 41·9	·210851	928
	3	29 22·51	6 49·8	·213701	934
Dec.	4	1 29 17·03	+2 9 8·6	0·216571	0·00940

1851.		R.A.	Decl.	Log Δ.	Time of Aberr. in parts of a Day.
		h m s	° ′ ″		
Dec.	5	1 29 13·23	+2 11 37·9	0·219461	0·00946
	6	29 11·12	14 17·8	·222368	952
	7	29 10·68	17 8·0	·225290	959
	8	29 11·90	20 8·3	·228227	965
	9	29 14·76	23 18·7	·231177	972
	10	29 19·27	26 38·8	·234138	979
	11	29 25·40	30 8·8	·237110	985
	12	29 33·15	33 48·2	·240091	992
	13	29 42·51	37 36·8	·243081	0·00999
	14	29 53·45	41 34·7	·246079	0·01006
	15	30 5·98	45 41·4	·249082	1013
	16	30 20·08	49 57·0	·252090	1020
	17	30 35·73	54 21·1	·255102	1027
	18	30 52·93	2 58 53·8	·258117	1034
	19	31 11·63	3 3 34·7	·261133	1041
	20	31 31·86	8 23·8	·264150	1049
	21	31 53·57	13 20·8	·267167	1056
	22	32 16·76	18 25·7	·270183	1063
	23	32 41·41	23 38·2	·273196	1071
	24	33 7·50	28 58·3	·276206	1078
	25	33 35·02	34 25·6	·279212	1086
	26	34 3·95	40 0·0	·282213	1093
	27	34 34·27	45 41·2	·285207	1101
	28	35 5·96	51 29·2	·288195	1108
	29	35 38·99	3 57 23·8	·291175	1116
	30	36 13·37	4 3 24·9	·294148	1124
	31	36 49·05	9 32·1	·297114	1131
	32	37 26·01	15 45·4	·300070	1139
	33	38 4·25	22 4·5	·303014	1147
	34	1 38 43·72	+4 28 29·3	0·305948	0·01155

HYGEIA.

IVERPOOL. Equatoreal. (Mr. Hartnup.)

51.	Green. M.T.	R.A.	N.P.D.	Comp[d]—Obs[d]. R.A.	Comp[d]—Obs[d]. N.P.D.	Stars of Comp. B.A.C.
	h m s	h m s	° ′ ″	s	″	
. 14	11 34 36·9	0 20 3·39	82 12 11·2	−1·57	+12·3	26, 8331
	12 16 29·9	2·28	18·9	1·65	11·1	— —
15	10 16 11·9	0 19 23·97	82 15 45·7	1·50	10·7	— —
	10 56 5·1	22·83	50·6	−1·51	+12·1	— —

The assumed *mean* places of the stars of comparison are those given for *Iris*. The observed places of the planet have been corrected for refraction and parallax. The computed places were deduced from the ephemeris contained in the supplement *to the Nautical Almanac* for 1854.

DURHAM. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1851.	Green. M.T. h m s	R.A. h m s	Exc. of Ephem. s	N.P.D. ° ′ ″	Exc. of Ephem. ″	No. of Comps. in R.A.	N.P.D.	Set.
Sept. 13	12 38 16·8	0 20 42·75	−1·59	82 8 44·5	+ 8·9	24	8	1
15	12 19 27·4	19 20·32	1·43	16 9·0	7·0	12	4	2
21	13 16 10·4	15 1·16	1·42	82 40 32·8	10·2	24	8	3
27	13 3 23·2	10 37·20	1·02	83 7 12·7	7·8	18	8	4
28	10 52 33·3	9 57·14	0·93	11 22·6	9·2	18	6	5
Oct. 2	12 1 57·6	7 1·03	1·07	30 19·6	8·4	6	2	6
6	9 54 52·1	4 15·14	0·94	48 48·4	11·5	9	3	7
7	10 30 42·8	3 32·65	0·81	53 41·0	10·2	24	8	8
	11 55 57·7	30·67	1·27	57·7	10·3	21	7	9
8	10 16 27·3	2 52·50	1·13	83 58 21·5	10·6	16	6	10
10	12 43 30·5	1 28·03	0·84	84 8 16·7	9·2	24	8	11
12	10 50 4·5	0 0 13·27	−0·64	84 17 16·3	+ 7·2	24	8	12

Parallax and computed places taken from Suppl. *Naut. Alm.* 1854.

Mean Places of Stars of Comparison, 1851·0.

Name.	h	R.A. h m s	N.P.D. ° ′ ″	Set.
Weisse	0, 318	0 19 13·49	82 15 48·4	1
—	0, 375	22 50·14	18 42·3	2
Green. T.Y.C.	16	12 55·98	82 38 15·3	3
Weisse	0, 169	10 1·75	83 4 7·2	4
Green. T.Y.C.	22	18 1·11	7 58·7	5
Weisse	0, 192	11 27·89	32 45·1	6
—	0, 97	6 4·79	53 20·0	7
—	0, 89	0 5 22·91	55 59·6	8
—	xxiii, 1222	23 59 26·52	83 57 9·9	9
—	— 1252	0 0 53·74	84 2 47·2	10
—	— 1251	0 0 46·54	84 12 46·6	11, 12

Hygeia appeared as a star of 10.11 magnitude.
Sept. 15 and Oct. 2. Interrupted by fog.
Oct. 6. Interrupted by cloud.
— 10. Observed through thin cloud.

IRIS.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1851.	Green. M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	Comp^d—Obs^d. R.A. s	N.P.D. ″	Stars of Comp. B.A.C.
Sept. 14	11 16 0·8	0 1 24·04	77 45 43·8	+1·62	−5·7	26, 8331
	11 57 53·7	22·98	49·1	1·36	6·2	— —
15	9 57 31·9	0 0 40·60	77 49 1·4	1·68	7·0	— —
	10 37 25·1	39·54	6·6	1·45	6·2	— —
20	*12 11 25·3*	23 56 36·19	78 10 47·5	+1·48	−7·2	26

The observed places have been corrected for parallax and refraction. The computed places were deduced from the ephemeris contained in the supplement to the *Nautical Almanac* for 1854.

The following are the assumed *mean* places of the stars of comparison derived from the Greenwich observations:—

	R.A.	N.P.D.
	h m s	° ′ ″
B.A.C. 26	0 5 34·05	75 38 41·02
— 8331	23 51 39·72	83 57 41·82

Durham. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1851.	Green. M.T.	R.A.	Exc. of Ephem.	N.P.D.	Exc. of Ephem.	No. of Comps. in R.A.	No. of Comps. in N.P.D.	Set.
	h m s	h m s	s	° ′ ″	″			
pt. 6	13 7 0·0	0 6 50·70	...	77 28 17·8	...	18	6	1
9	10 59 1·8	4 59·83	+0·92	32 35·7	−5·2	24	8	2
	12 16 3·9	57·51	1·09	41·8	5·1	15	5	3
10	11 37 6·1	4 17·90	1·07	34 40·4	3·8	18	6	4
13	11 18 11·5	2 9·28	1·33	42 30·5	3·4	24	8	5
	11 57 17·4	8·18	1·22	34·7	2·7	24	8	6
15	10 59 46·8	0 0 39·22	1·06	77 49 7·0	3·3	24	8	7
28	10 1 19·2	23 50 2·44	1·57	78 56 40·4	1·1	18	6	8
ct. 2	10 11 52·3	46 50·68	1·31	79 24 22·2	5·7	24	8	9
	10 52 0·1	49·01	1·68	32·9	4·4	24	8	10
4	9 56 33·5	45 19·64	1·64	38 48·9	5·0	9	3	11
6	9 9 8·8	43 54·00	1·57	79 53 28·0	5·1	24	8	12
12	9 49 23·5	23 40 2·78	+1·15	80 39 24·2	−0·4	24	8	13

Parallax and computed places taken from Suppl. *Naut. Alm.* 1854.

Mean Places of Stars of Comparison, 1851·0.

Name.	R.A.	N.P.D.	Set.
	h m s	° ′ ″	
Weisse, 0^h, 128	0 7 52·28	77 24 30·9	1, 2
B.A.C. 8370 (Edin. Obs.)	23 58 3·29	25 57·7	3, 4
Weisse, 0^h, 60	0 3 40·24	46 16·8	5
— xxiii, 1236	0 0 3·19	44 42·7	6
— — 1201	23 58 21·15	77 57 16·2	7
— — 927	45 23·46	78 54 5·9	8
— — 1030	50 9·46	79 21 15·8	9
— — 1000	48 52·24	31 54·3	10
— — 1010	49 22·90	36 36·7	11
B.A.C. 8300 (Edin. Obs.)	45 1·36	79 52 52·6	12
Weisse, $xxiii^h$, 775	23 37 46·56	80 38 46·6	13

Iris shone as a star of 7.8 magnitude, and was exceedingly brilliant on some of the earlier nights in September.

HEBE.

HAMBURG. (M. Rümker.)

1851.	Hamburg M.T. h m s	R.A. h m s	Decl. ° ′ ″	No. of Comps.	
July 3	10 40 55·6	19 26 59·35	− 8 8 30·2	10	Equatoreal
5	10 51 8·9	25 10·11	8 21 57·8	17	—
11	10 8 38·9	19 31·80	9 6 49·2	6	—
12	10 18 5·9	18 33·02	15 2·5	20	—
15	10 58 2·4	15 36·32	40 47·8	6	—
16	11 37 53·8	......	49 45·0	Meridian Circle	
17	32 59·8	13 38·24	9 58 46·3	—	—
18	28 6·3	12 40·50	10 7 50·0	—	—
21	13 27·8	9 49·16	35 51·0	—	—
22	11 7 35·9	7 52·95	10 45 29·9	—	—
24	10 58 53·4	7 2·07	11 4 59·1	—	—
27	44 26·4	4 22·52	34 55·5	—	—
28	39 38·5	3 30·45	11 45 3·3	—	—
30	10 30 7·6	19 1 50·95	12 5 30·5	—	—
Aug. 6	9 57 28·5	18 56 42·41	13 18 13·6	—	—
8	48 22·0	55 27·59	39 5·9	—	—
9	43 51·5	54 52·94	13 49 31·9	—	—
10	9 39 22·8	18 54 19·99	−14 0 0·4	—	—

These observations are not corrected for parallax.

Mean Places for January 0, 1851, of stars in the track of *Hebe*, from observations with the meridian circle at Hamburg.

R.A. h m s	Decl. ° ′ ″	R.A. h m s	Decl. ° ′ ″
18 41 31·18	− 9 7 0·2	19 13 22·42	−10 38 39·2
51 21·22	13 58 ...	13 33·77	10 40 19·3
53 49·69	13 27 38·5	14 41·50	10 18 43·0
55 0·20	12 55 13·6	15 48·53	9 39 42·8
57 57·21	13 31 14·8	16 14·19	9 37 19·4
58 55·81	12 53 51·0	17 48·60	9 18 9·8
59 1·61	13 3 53·4	19 45·64	9 24 12·4
59 24·03	12 37 35·9	21 44·36	8 19 24·4
18 59 34·18	12 58 30·0	22 30·03	8 44 29·4
19 0 13·74	12 36 21·7	24 22·89	9 19 9·0
4 26·40	11 47 40·7	24 52·74	8 18 37·1
5 0·05	11 14 44·6	27 27·18	7 46 53·9
6 31·28	11 7 17·3	27 33·57	7 38 19·4
6 39·75	10 58 24·9	30 18·71	8 38 47·5
6 38·92	11 9 44·7	31 23·33	7 33 23·5
8 31·52	10 25 53·5	32 25·37	7 57 8·7
11 14·13	10 35 0·4	32 42·21	7 51 2·2
12 4·40	10 13 48·9	19 32 48·58	− 7 58 ...
19 12 11·12	−10 49 54·2		

EGERIA.

*Ephemeris.** By M. G. Rümker.

12^{h} Berlin Mean Time.

ate. 1851.	R.A. h m s	Decl. ° ′	Log. Δ	Date. 1851.	R.A. h m s	Decl. ° ′	Log. Δ
v. 0	10 52 21	+23 15·3	0·42067	Dec. 1	11 40 11	+20 42·7	
1	54 3	9·3		2	41 32	39·3	0·35804
2	55 45	+23 3·4		3	42 52	36·0	
3	57 26	+22 57·5		4	44 11	32·7	
4	10 59 6	51·7	0·41369	5	45 29	29·6	
5	11 0 45	45·9		6	46 46	26·7	0·34918
6	2 25	40·2		7	48 2	23·9	
7	4 4	34·5		8	49 17	21·2	
8	5 42	28·9	0·40646	9	50 31	18·7	
9	7 19	23·4		10	51 45	16·3	0·34010
10	8 56	17·9		11	52 58	14·0	
11	10 32	12·5		12	54 9	11·8	
12	12 8	7·1	0·39900	13	55 19	9·7	
13	13 43	+22 1·8		14	56 29	7·8	0·33083
14	15 17	+21 56·6		15	57 37	6·1	
15	16 51	51·5		16	58 45	4·5	
16	18 24	46·5	0·39128	17	11 59 51	3·1	
17	19 56	41·6		18	12 0 56	1·8	0·32138
18	21 28	36·3		19	2 0	+20 0·6	
19	22 59	32·1		20	3 3	+19 59·5	
20	24 29	27·4	0·38333	21	4 5	58·6	
21	25 58	22·9		22	5 5	57·9	0·31178
22	27 27	18·4		23	6 4	57·3	
23	28 55	14·0		24	7 2	56·9	
24	30 23	9·7	0·37513	25	7 59	56·7	
25	31 49	5·6		26	8 54	56·6	0·30206
26	33 15	+21 1·5		27	9 48	56·7	
27	34 40	+20 57·5		28	10 41	56·9	
28	36 4	53·6	0·36670	29	11 33	57·2	
29	37 27	49·9		30	12 24	57·6	0·29225
30	11 38 50	+20 46·2		31	12 13 14	+19 58·1	

* From Professor Encke's elements, *Berliner Jahrbuch*, 1854.

D'ARREST'S NEW COMET.

Dr. d'Arrest, of the Leipsic Observatory, discovered a faint comet in the constellation *Pisces* on the night of June 27. The place could only be estimated roughly on account of twilight.

	Leipsic M.T.	R.A.	Decl.
	h m	° ′	° ′
1851, June 27	13 10	7 49	+10 32

The next night was cloudy; but on the night following Dr. d'Arrest obtained two comparisons of the comet with *Weisse* 0h, 690, which were as satisfactory as the extreme faintness of the comet would allow.

	Leipsic M.T.	R.A.	Decl.
	h m s	° ′ ″	° ′ ″
1851, June 29	13 14 5	10 4 47	+10 37 35

CAMBRIDGE. Northumberland Equatoreal. (Prof. Challis.)

1851.	Greenwich M.T.	R.A.	Log $\frac{p}{P}$	N.P.D.	Log $\frac{q}{P}$	No. of Comps.	Star
	h m s	h m s		° ′ ″			
Aug. 7	13 56 3·7	3 7 34·79	−8·561	81 59 5·7	−9·8684	7	*a*
21	12 46 58·7	3 42 34·22	8·597	84 31 7·5	9·8849	6	*b*
Sept. 22	13 6 57·9	4 22 42·55	−8·480	91 41 31·5	−9·9024	8	*c*

The comet on Sept. 22 was faint, and so much diffused that it was difficult to fix upon the brightest point. The following are the assumed *mean* places, 1851·0, of the stars as derived from the Catalogues.

	Mean R.A.	Mean N.P.D.	Name of Star.
	h m s	° ′ ″	
a	3 4 36·17	81 58 13·6	Bessel (Weisse), iii^h, 62
b	3 37 45·77	84 25 14·3	*u′* Tauri = B.A.C. 1162
c	4 18 6·55	91 45 16·2	Bessel (Weisse), iv^h, 376

DURHAM. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1851.	Green. M.T.	R.A.	Log $\frac{p}{P}$	N.P.D.	Log $\frac{q}{P}$	No. of Comps. in R.A.	N.P.D.
	h m s	h m s		° ′ ″			
Aug. 24	14 49 36·5	3 48 54·85	−8·426	85 8 54·7	−9·8892	4	4
30	13 52 42·2	4 0 21·30	8·499	86 24 44·9	9·8982	4	4
Sept. 1	14 30 19·1	2 53·83	8·428	86 51 11·7	9·8972	5	5
6	14 33 29·2	4 9 51·97	−8·395	87 59 55·0	−9·9016	8	8

P is the equatoreal horizontal parallax in seconds of arc; *p* and *q* are the required corrections in time and arc respectively.

Mean places of Stars of Comparison, 1851·0.

Name.	R.A.	N.P.D.	Set.
	h m s	° ′ ″	
Weisse, iii^h, 972	3 49 54·30	84 57 0·9	1
— — 1103	3 56 53·49	86 34 24·8	2
— iv^h, 124	4 7 0·25	87 0 42·4	3
— — 180	4 9 32·04	87 50 32·7	4

D'Arrest's comet, as seen here, exhibited no nucleus; the errors of observation will consequently be large. The first observation was taken with a wire-micrometer, the three last with a ring-micrometer, radius 444″. The correction for refraction has been applied. Cloudy weather prevented observation previous to July 18; I was then absent from Durham till August 18. Attempts since Sept. 6 have been unsuccessful.

*Elliptic Elements.**

By M. E. Vogel, from observations on July 2, and July 23, August 4, at Berlin.

	° ′ ″	
M	0 0 0·0	1851, July 8·98442, Berlin M.T.
ϖ	323 55 11·7	Mean Equinox, 1851, Jan. 0.
☊	149 8 17·3	
i	14 10 47·4	
ϕ	43 33 30·0	
Log e	9·838278	
Log a	0·580140	
Log μ	2·479797	
Periodic Time	2708days·994	(Motion direct.)

Compd—Obsd.

δ. long. = −0″·2

δ. lat. = −0·1

By Mr. Norman Pogson, from the following observations:—

1851.	Mean Time at Place. h m s	R.A. ° ′ ″	Decl. ° ′ ″	
June 29	13 4 5	10 4 47·0	+10 37 35·0	Leipsic
July 6	13 21 10	17 46 6·6	10 49 20·0	Bonn
24	13 11 49	35 33 50·4	+ 9 53 7·5	—

T	July 10·002868	Greenwich M.T.
	° ′ ″	
ϖ	324 7 48·05	Mean Equinox, August 1.
☊	148 13 14·39	
i	14 4 2·26	
ϕ	38 31 36·71	
e	0·6228820	
Log a	0·4923758	
Log q	0·0688536	
Log μ	2·8114429	
μ	647″·80271	
Period	2000days·61	

"The middle observation is represented in longitude within 0″·80, and in latitude within 0″·04.

"The periods obtained by those astronomers who have undertaken the calcula-

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* Mr. George Rümker forwarded parabolic elements and an approximate ephemeris; *these elements* are superseded by the later determinations.

tion of the orbit of this comet are remarkably discordant, as may be perceived from the following comparison :—

Villarceau	2921 days.
Vogel	2709
D'Arrest	2577
— (corrected elements from normal places)	2353
Pogson	2001

"Of these, D'Arrest's corrected elements are, I believe, nearest the truth, and will serve to follow the comet during the remainder of its present apparition.

"With the larger telescopes it will probably be visible for some time longer; and as so much uncertainty exists at present with respect to the time of its return, it is to be sincerely hoped that such valuable observations will be obtained."

BRORSEN'S FOURTH COMET.*

On August 1, at about $11^h 45^m$ P.M., M. Brorsen, of Senftenberg, discovered a telescopic comet in *Can. Venat.* Though small, he calls it very bright. By seven comparisons with Bessel's star, Zone 413, 8th mag., $13^h 53^m 57^s{\cdot}12 + 31° 31' 40''{\cdot}2$, he obtained the following place :—

1851.	Senftenberg M.T. h m s	R.A. Comet. h m s	Dec. Comet. ° ′ ″
Aug. 1	13 9 21·4	13 54 58·43	+31 27 7·3
Daily variation		+1 32·9	+ 23 25

ALTONA. (Dr. Petersen.)

1851.	Altona M.T. h m s	R.A. h m s	Dec. ° ′ ″
Aug. 4	11 25 53	13 59 58·93	+32 48 2·6

The air so thick and unfavourable that the comet was seen with difficulty. The observation in declination not to be relied on.

HAMBURG. (M. Rümker.)

1851.	Hamburg. M.T. h m s	R.A. ° ′ ″	Dec. ° ′ ″
Aug. 4	11 16 11·5	209 59 43·8	+32 48 22·1
5	11 10 0·7	210 26 21·2	33 15 36·5
6	10 47 25·4	210 53 15·7	33 42 25·8
19	10 46 6·3	217 42 25·4	39 51 13·0
21	9 40 52·3	218 55 17·2	40 48 37·7
22	9 36 19·6	219 33 30·4	41 18 1·0
24	9 49 35·1	220 53 51·4	42 18 2·2
25	9 16 51·5	221 36 36·7	42 48 36·4
28	9 20 36·7	223 47 18·1	44 18 52·7
29	10 38 26·2	224 36 27·8	44 51 15·3
Sept. 6	9 37 38·1	231 49 28·2	+48 59 39·7

* *This was also discovered by* M. Schweizer at Moskow, on August 21.

1851.	Hamburg M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″
Sept. 15	9 15 36·6	243 15 27·5	+53 38 42·9
18	9 41 21·3	248 16 46·2	55 5 10·6
22	9 37 10·7	256 5 57·7	56 45 49·9
26	10 32 39·5	265 33 59·0	57 59 30·7
27	9 44 34·8	268 4 24·7	+58 10 22·2

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1851.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	Star of Comp.
g. 13	10 18 21·4	14 17 16·87	+8·690	53 1 35·4	−9·7558	B.A.C. 4812
	10 38 20·3	18·29	8·695	1 18·3	9·7788	— —
	10 58 19·5	20·21	8·698	0 52·4	9·8007	— —
15	10 24 47·4	14 21 37·28	8·699	52 4 26·8	9·7605	— —
	10 39 46·4	38·28	8·702	4 14·0	9·7781	— —
	10 54 45·5	39·49	8·703	3 53·7	9·7950	— —
25	9 14 18·0	14 46 23·59	8·700	47 11 56·5	9·6346	B.A.C. 4958
	9 34 17·4	25·45	8·714	31·8	9·6667	— —
26	9 49 11·8	14 49 18·85	8·726	46 40 56·7	9·6831	— —
	10 4 11·5	20·68	8·732	40·6	9·7093	— —
	10 19 10·8	21·93	8·736	17·0	9·7312	— —
pt. 6	9 53 59·5	15 27 29·46	8·775	40 58 59·6	9·6416	B.A.C. 5177
	10 14 0·8	33·55	+8·781	38·1	−9·6784	— —

The observations are corrected for refraction. The corrections to be applied for parallax in time and arc are represented by *p* and *q*. P is the equatoreal horizontal parallax.

The following are the assumed *mean* places of the stars of comparison for 1851·0:—

	R.A. h m s	N.P.D. ° ′ ″	Authority.
B.A.C. 4812	14 26 4·63	51 2 16·13	Greenwich 12-year Catalogue.
— 4958	14 56 20·07	49 1 9·78	— — —
— 5177	15 33 30·00	42 42 32·01	Oxford and Edinburgh Observations.

DURHAM. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1851.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	No. of Comps. in R.A.	N.P.D.	Set.
g. 19	11 0 19·0	14 30 54·57	+8·697	50 7 53·0	−9·8100	18	6	1
20	10 57 16·0	33 21·45	8·603	49 38 46·6	9·8058	15	5	2
21	10 9 15·1	35 46·43	8·702	49 10 19·8	9·7474	8	3	3
26	10 45 8·8	14 49 25·09	8·724	46 39 48·5	9·7820	7	3	4
30	10 38 37·1	15 1 43·41	8·739	44 37 17·0	9·7637	14	5	5
pt. 1	12 52 51·0	8 49·24	8·661	43 31 45·9	9·9034	5	5	6
5	9 56 6·6	15 23 23·45	8·759	41 29 57·5	9·6733	6	6	7
21	10 57 28·7	16 56 41·50	+8·842	33 35 25·1	−9·6429	5	5	8

P is the equatoreal horizontal parallax in seconds of arc; p and q are the *required corrections* in time and arc respectively.

Mean places of Stars of Comparison, 1851·0.

Name of Star.	R.A. h m s	N.P.D. ° ′ ″	Set.
Lalande, H.C. 2664	14 28 50·47	49 55 1·0	1
— 26804	34 48·25	49 28 3·7	2
Green. T.Y.C. 1182	37 57·50	48 54 29·0	3
Lalande, H.C. 27279	50 32·27	46 36 19·2	4
Green. T.Y.C. 1218	14 57 50·76	44 46 15·1	5
Argel. Z. 118, No. 7	15 4 33·73	43 42 14·8	6
Groomb. 2239 (Johnson)	15 24 38·87	41 46 22·7	7
Argel. Z. 13, No. 68	17 5 4·42	33 38 27·0	8

No nucleus traceable; the comet has gradually been becoming fainter; it was a very difficult object on Sept. 21. I have seen it twice since that date, but have been unable to procure any observation. The ring-micrometer was used on the three last occasions.

CAMBRIDGE. Northumberland Equatoreal. (Prof. Challis.)

Greenwich M.T. 1851.	h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	No. of Comps.	Star.
Aug. 11	10 44 28·2	14 13 9·68	+8·704	53 57 36·9	−9·7937	6	*a*
18	12 49 45·8	28 41·43	8·652	50 34 47·8	9·9113	5	*b*
28	12 38 28·9	14 55 38·37	+8·686	45 26 21·6	−9·8985	5	*c*

Assumed *mean* places of the stars, 1851·0.

	Mean R.A. h m s	Mean N.P.D. ° ′ ″	Name of Star.
a	14 11 41·56	53 48 2·1	B.A.C. 4747
b	14 26 4·84	51 2 17·0	γ Böotis = B.A.C. 4812
c	14 56 32·15	45 42 17·6	H.C. 27447

The places of the catalogues have been adopted.

*Elements.**

By M. G. Rümker.

Perihelion Passage, 1851, Aug. 26·216505.

	° ′ ″	
Longitude of Perihelion......	309 51 7	App^t Eq^x
— Node............	225 1 1	Aug. 4.
Inclination	40 9 24	
Log *q*	9·999860	

Motion direct.

In the course of the vacation, Lieut. Stratford published an ephemeris of the periodic comet discovered by Brorsen, Feb. 26, 1846, which was expected to return this autumn. The place of the comet is given on three suppositions, that its perihelion passage occurs on Nov. 10, or eight days sooner or later.

* *M. G. Rümker* was also so obliging as to forward an approximate ephemeris.

Observations made at Paramatta during the Eclipse of the Sun on Saturday, February 1, 1851. By the Rev. W. B. Clarke.

The account given by Mr. Clarke of the observations, of which an abstract is here given, was originally published in the *Sydney Morning Herald*, and has been since forwarded by that gentleman to the Society. The observations were made at Newlands, Paramatta, by Mr. Clarke, in conjunction with Captain P. King. As it is certain that the eclipse was annular at some place near Sydney, and as some doubts are entertained whether certain interesting phenomena that were seen at the time of greatest obscuration were due to the completion of the annulus, or to the near approach to it, Mr. Clarke has appended a plan of the localities in the neighbourhood of the place of observations, from which it appears that his station was the most northerly of all at which observations were taken, but that it probably lay without, though very near to, the northerly limit for the annular eclipse. On the whole, he considers that the annulus was not complete at his station.

The observations made by Mr. Clarke were chiefly meteorological, though he occasionally viewed the progress of the eclipse both through the telescope used by Captain King, which was provided with a red shade, and through another provided with a green shade.

For the meteorological observations Mr. Clarke had Captain King's standard barometer, and an aneroid of his own, which was first compared with it. He had also two thermometers with blackened bulbs, from one of which he had removed the scale by means of a hinge, so as to have the bulb and part of the tube perfectly free; and this he had compared with a standard before commencing. The other had a brass scale unremoved, and both were so placed in a shallow box as to receive the full effect of the sun's rays. Besides these, he was furnished with a wet and a dry bulb thermometer, and with a Daniell's hygrometer.

The meteorological observations we shall classify under the heads, pressure of the air, temperature, radiation, and humidity. The other observations relate to obscurity, effect on vegetation, and the direct phenomena of the eclipse.

Pressure of the Air.—No barometrical results are indicated which show any effect of the eclipse. The small changes in height during its progress are in accordance with the ordinary laws.

Temperature.—The depression of temperature due to the eclipse was found to be $2^{\circ}\cdot 82$ at $5^{h}\ 24^{m}$ (the depression for the time of day being allowed for), and this depression continued for about 32 minutes.

Radiation.—The effect on this element was very remarkable. The indications of the brass scale thermometer varied from 111° to 71°, or gave a difference of 40°. The indications of the thermometer with the bare bulb varied from 92° to 68°, giving a difference of 24°. Sudden and frequent variations occurred, which Mr.

Clarke attributes to insensible vapours in the atmosphere. At the time of greatest obscuration the radiation thermometers stood at about the same height as the dry thermometer.

Humidity.—The dew-point, as calculated by the indications of the dry and wet bulb thermometer, varied from $64^{\circ}\cdot1$ to $61^{\circ}\cdot6$, the corresponding dry temperatures varying from 73° to $69^{\circ}\cdot5$. The greatest humidity occurred about the time of the middle of the eclipse.

Obscurity.—Mr. Clarke fancied that the cattle seemed affected by the diminution of light, and he was informed that fowls in some places were preparing for roost. The appearance was that of early morning; but the general hue to the naked eye, at the greatest observation, was that of a pale, sickly green.

Effect on Vegetation.—Immediately beneath the verandah whereon the observation was made grew a plant called the "Four o'clock flower," from the time of the usual opening of its blossoms. Three petals began to unfold, but during the greatest obscuration they closed again; nor did they fairly unfold till the eclipse was nearly over.

Direct Phenomena of the Eclipse.—By Captain King's observations, the eclipse commenced at $4^{h}\ 6^{m}\ 6^{s}$, local time, and terminated at $6^{h}\ 31^{m}\ 35^{s}$. He observed with a refracting telescope of 44 inches focal length, and of $2\frac{1}{4}$ inches aperture, mounted equatoreally, using a power of about 40. He made, during the eclipse, several drawings of the solar spots, and of the different phases of the obscuration.

Mr. Clarke describes the moon as looking spherical and dark, "like a huge cannon-ball, that, having been corroded, is painted black. Its limb was generally far more distinct than that of the sun. A kind of mirage played along the inner edge of the sun's limb, and on the outer edge of the moon, accompanied by undulations. The cusps of the sun were generally most beautifully and delicately defined; but, towards their nearest approach, the points were blunted at one time, and protusions of black interspaces, like slopes of a mountain, divided the light at the angle."

From the near approach to an annular eclipse which took place at his station, Mr. Clarke was prepared to expect something like the phenomenon of "*Baily's beads;*" and when the cusps approached nearest to each other, he was anxiously watching at the telescope. He saw distinctly a formation of the "beads," with "dark bands" between, uniting the edges of the sun and moon near the points of the cusps, just as they are described by Mr. Baily; and he then saw flashes of *white* light rush across the dark portion of the moon from each cusp, but he did not see them unite, though they approached very close to each other.

Captain King saw the junction very nearly all round. Mr. Clarke did not see it all round; but the threads of light were very near to each other; and his impression was that it was not the sun's body, but light glancing rapidly from one summit of the moon to another, "either refractions from the sun, or reflected earth-light: but the

lights certainly came from the direction of either cusp, and nearly touched. This phenomenon lasted but a very few seconds."

Some gentlemen, who threw the image of the sun upon a screen through their telescopes and theodolite-glasses, say they saw the line well defined all round upon the paper. The light, on the contrary, which Mr. Clarke saw, was in rapid projection, quickly disappeared, and was quite *white;* whilst the sun's light in the telescope was that of the *green* screen.

Mr. Clarke's observations of the eclipse have convinced him that, if the moon have any atmosphere, it is of extreme rarity; but, by observations of the eclipses of several spots, he is induced to think that there is *some* atmosphere, however rare.

An Account of placing Meridian Marks for the Stonyhurst Transit Circle. By the Rev. A. Weld, F.R.A.S.

"As the observatory of Stonyhurst possesses the advantage of a well-defined and unobstructed horizon, both in the northern and southern direction, it had long been my wish to fix marks exactly on the north and south points, with which I might compare the position of the transit circle, and so be aware, at sight, of any change that might take place in the bearings of the instrument. I believe the existence of a good meridian mark is always looked upon as an advantageous circumstance in the equipment of an observatory; and since on our horizon there was no object sufficiently defined, and near enough to the meridian, to answer that purpose well, I thought it worth while, to remedy that defect, to determine the exact north and south points of the meridian passing through our transit circle, and to fix marks there which should be easily seen with the ordinary observing power of the telescope.

"I must first state that the north and south points in our horizon are between four and five miles distant from the observatory, the northern being about 500, and the southern 300 feet above our level.

"The first object to be gained was to find the south point approximately, so as to confine our operations within the field of the telescope. This was effected in the following manner:— Two high poles were erected approximately in the meridian line; on the top of one an English, and on the other a French flag was hoisted. The object of these was to guide the exploring party into the right direction: this was known by the flags appearing in the same line. An observer accustomed to the use of telescopes was stationed in the observatory, with an assistant at each flag-post to work the signals, and two others to convey the requisite messages; whilst I went myself, with two or three others, to the hills, provided with a hand-telescope, a small flag, and a staff about eight feet long.

"It was arranged, before starting, that both flags should fly until we appeared on the horizon within the field of the telescope of the transit circle.

"The falling of one of the flags was the signal that we had *been thus seen, and* were therefore within a short distance of the

point of which we were in search. It was further arranged that as long as we were a little too much to the west the English flag alone should fly; and, on the other hand, the French flag was the signal that we were a little east of the meridian, though visible within the field of the transit.

"The first expedition was made on March 6th, and we succeeded very well in fixing the point approximately. We wandered some time on the hills before our little flag was descried from the observatory; but at length the falling of the French flag satisfied us that we were seen and understood, and the rapid change of the flags as we passed and repassed the meridian convinced us that active and prompt co-operation was afforded us from the observatory. The staff that had carried our flag was driven in, to serve as a mark, until a firmer and more permanent one could be obtained.

"This staff, which was about one inch and a quarter in thickness, was seen distinctly from the observatory (when the day was clear), as a line considerably finer than the spider-lines of the telescope.

"I now determined to remove the angle of collimation of the middle wire of the telescope, so as to make it coincide with the same point on the horizon in both positions of the axes of the instrument. This was done to my entire satisfaction; and I found that whether the illumined axis was east or west, and whether the telescope was turned to the north or south horizon, the middle wire agreed sensibly with the same distant points. This wire, however, does not coincide exactly with the mean of the system of five wires; but the interval between it and the mean has been carefully determined from twenty-six entire transits of *Polaris*, above and below the pole.

"I endeavoured also to reduce, as far as possible, the error of azimuth, in order, once for all, to fix the exact point where our meridian cuts the horizon. At the same time no opportunity was lost of carrying out the operations on the hill.

"It will readily be imagined that the distance, added to the uncertainty of the weather in a hilly country, must have occasioned many failures and consequent disappointments.

"On April 3d, the day being clear, I made a successful attempt. A heavy post of oak was procured, about nine feet in length and eight inches in thickness; this was surmounted by a cross consisting of two bars of iron, each two feet in length and two inches in breadth, hammered together in the middle, and driven by means of two strong spikes into the top of the post. The usual signals were used, with the additional understanding that both flags should fall promptly when the post was so placed that the cross of the bars was bisected by the middle wire of the transit. The signals were seen without difficulty; but I afterwards found from Mr. Vaughan, who superintended in the observatory, that the atmosphere was so unsteady that nothing could be determined with accuracy.

"No convenient opportunity offered itself for another expedition till April 26th, when I dug up the post, and succeeded in

planting it, I believe, with great accuracy in the meridian. On returning home I found the × intersected by the middle wire, but it did not appear to be perfectly bisected by it; the atmosphere was, however, rather disturbed at the time.

"A day or two after, the × appeared to me to be perfectly bisected by the middle wire; and as I have reason to believe the instrument was at that time very nearly in the meridian, I considered the position of the south point sufficiently determined.

"From observations on April 25th, on *α Urs. Maj.* and *δ Hyd. et Crat.*, I calculated the azimuthal error to be $+0''\cdot12$; and on April 29th the mean of the two results obtained from *β^1 Scorpii* and *ξ Urs. Min.* with illumined axis east, and *α Ophiuchi* and *ε Urs. Min.* with illumined axis west, was $-0''\cdot36$.

"So small an arc as either of these, when measured along the horizon, being quite an invisible quantity with the ordinary power of the telescope, I thought there was no use in trying to bring the instrument any nearer to the meridian.

"The only point of interest that remained was to measure the interval along the horizon which corresponded to the interval between two wires, that, knowing the space corresponding to a given arc, I might form an idea of the accuracy of the results which the meridian mark will afford, at the same time that I could calculate the distance from it to the observatory.

"The interval between two of the wires, measured on the ground, was 39 feet, and the equatoreal interval for the same wires $= 24^s\cdot34 = 6'\ 11''\cdot10$. This gives 4·13 miles as the distance of the mark from the observatory.

"The northern point was found in the same manner as the south, by expeditions made on April 21st, May 1st, 8th, and 22d, and is marked by a heavy larch-pole, 14 feet in length, and sunk 4 feet deep into the ground. On the top is a cross similar to that used in the south, with this difference, that the bars are 3 feet instead of 2 in length. The distance between two wires, measured along the north horizon, was 45·3 feet, which gives 4·8 miles as the distance from the observatory."

1851, April 10, Mr. Weld observed the occultation of a small star by the dark limb of the moon, at $12^h\ 36^m\ 59^s\cdot7$ Stonyhurst sidereal time. H.C. 18007.

On some Improvements in Reflecting Instruments.
By Prof. Piazzi Smyth.

In the course of his lectures on Practical Astronomy to the students of the Edinburgh University last winter, Prof. P. Smyth had unusual opportunity of ascertaining those points in the making of the generality of the observations of navigators by sea and of travellers on land, which presented the greatest difficulty to beginners. And as these points generally consisted of needless peculiarities, sometimes absolute imperfections in the instruments, the *Professor proceeded* to remove them as well as he could, and

the result may, perhaps, be more extensively useful, especially as the difficulties were generally felt on the sextant being applied to observations of *stars by night*, a more exact means than the sun by day, and therefore to be encouraged and assisted in every way.

In naval observations the impediments were, both by the experience of the class, and by the testimony of naval officers,

1st. Difficulty of seeing and of bringing down the star.

2d. Difficulty of seeing the horizon line at night.

3d. Difficulty of reading off the angle on the limb.

The first of these, in so far as it depended on the dark field of the telescope, he proposed to remedy by employing a telescope of large aperture, say 2 inches, in place of the usual size, $\frac{1}{2}$ or $\frac{3}{4}$ inch; in so far as the loss of light was occasioned by reflexion and absorption at the glasses, he intended to remove this by employing *metal* reflectors, by which, too, the occasional nuisance of *second* images would be avoided and greater accuracy obtained. He had tried speculum metal for the purpose with great advantage; but, under some circumstances, he was in hopes of being able to employ silver, which has lately been found to be capable of reflecting near double the amount of light that speculum metal does, though that retains more than quicksilvered glass; and then, in so far as the loss of the star in "bringing down" is caused by the diminished surface exposed by the index-glass at large angles, he proposed to make that larger than usual: besides which, the reflexion taking place in the metal at the first surface, there would be no loss, as now, from the thickness of the edges of the glass or the sides of the brass box containing it.

The second difficulty would be alleviated by the same adoption of the large object-glass: besides the loss of light by transmission through the so-called transparent part of the present horizon-glass would be done away with by the employment of the metal reflectors.

The third difficulty was also shown to be gratuitous, for the reflector of the reading-glass was in general so placed that the light of the lamp could not get to it, and if it did, would be thrown away from the arc instead of on it: and were even that managed, the surface of the vernier and arc being in different planes, the same ray of light would not illumine them *both* at the *same* time. By placing them, however, both in the same plane, and by putting the reflector at an angle of 45° to the limb, instead of parallel to it, so as to receive parallel light and throw it straight down to the divisions, it was found that they could easily be read by a very faint light.

For accuracy, opposite readings were deemed essential, and a circle insisted on in place of a sextant or quadrant; and the author, considering that the failure of the reflecting circle in securing a permanent footing in the navy arose from its being made in general too large and heavy, and complicated, he had devised a very small, but strong and simple form; the telescope was more firmly connected by moving in grooves on the large surface of the *face of the circle*, instead of rising by the usual single screw; and *in place of the* inconvenient plan of having to reverse the hands so

s to put the instrument into its box face uppermost, (which makes ıe getting of it out again without pulling at the reflector or some uch delicate parts, difficult) by placing the legs not on the back ut on the face, the instrument may be either put into its box, r down on the floor, or anywhere, face first, with the same hand 'hich was moving it in the observation, with the divisions and ıe reflectors protected from all accidents, and the whole instru- ıent ready at any time on a moment's notice (for the telescope ever need be taken off, with its improved fixing), to take advantage f an instantaneous opportunity of observation.

So much for the use of the reflecting instrument at sea: as used n land, the following difficulties were found, and are generally re- ognised:—

1st. The impossibility of measuring in the mercury either sun or star when within, say 20° of the zenith, from the reflecting instrument not taking in so large an angle; and again, when within, say 10° of the horizon, from the foreshortening of the reflecting surface.

2d. The difficulty of seeing the referring point all night, viz. the reflected image of the star, when black glass is employed; and the trouble with wind when employing mercury, as well as with other causes producing vibration; and the great weight and liability to loss in long journeys through difficult and uncivilised countries.

All these difficulties seemed to be met by making the reflecting urface of speculum metal, levelled by a spirit-level; and when the eflected object could not be seen, attaching to the metal a col- imating telescope, whose optical axis was parallel with the pre- iously levelled surface, and was defined at the focus end by a orizontal slit, illuminated by a lamp at night, so as completely to emove all difficulty of seeing the referring object, and allowing of lmost the whole object-glass being brought to bear on the star.

Difficulty having been found by the students in keeping sight f an object reflected from the artificial horizon, the latter was ;enerally placed on a stand so as to bring it near the eye, and nake it thereby offer a large angular space, which was pretty sure ıot to be exceeded by the shaking of the hand or involuntary novement of the head of an unpractised observer; but it was ound requisite, not only to make the stand firm, but to improve he steadiness of the levelling screws, which was done by making hem parts of a fixed frame, with the reflector moveable on them, nd capable of being fastened in any position between opposite uts.

A sextant with all the improvements (except the opposite read- ngs), a full-sized model of a circle, and one of the reflecting orizon, were shown; but Prof. Smyth did not mean to claim any art of them as his own invention; for, without making any special ıquiries as to how far he might have been preceded by any one lse, he believed that he had only brought to bear on this subject ıdividual *improvements* long and well known in other departments f *the science: but* as they had never, he thought, been so com-

pletely united before, and as such a reunion might enable observations often to be obtained when now they are given up, he hoped that the communication might not be uninteresting to some of the numerous working members of the Society.

Bond's Ring of Saturn. Extract of a Letter from Mr. Hartnup.

"On the 15th September we had here one of those superb nights with which we are so seldom favoured. I never before saw *Saturn* so beautifully defined. The main division in the bright ring was steadily seen in every part, except where the ring was hid by the belt of the planet.

"Bond's ring could not be overlooked for an instant. I examined it carefully with powers from 170 to 1133, with all of which it was seen, but most distinctly with 404 and 606. The new ring is much broader than represented by Prof. Bond and Mr. Dawes when first discovered. It occupies full half, or from half to two-thirds of the space between the inner bright ring and the ball of the planet. It has a mottled appearance, is most distinct near its junction with the inner bright ring, and fades away as it approaches the ball of the planet."

M. C. Rümker has forwarded transits of the moon and moon-culminating stars over the meridian of Hamburg, for the following days:—

	1850.	
Jan. 20	May 22	Aug. 18
21	23	19
Feb. 22	June 17	20
April 18	19	Sept. 12
19	20	15
22	22	16
May 19	July 18	Oct. 13
20	21	Nov. 12
21	22	
	1851.	
Jan. 11	Feb. 13	June 6
14	23	8
15	Mar. 10	10
Feb. 7	14	11
10	May 10	July 11
11	12	

which are deposited in the archives for the use of those who may want corresponding observations.

On August 16, M. Hencke of Driesen observed a star in *Aquila*, of the 9th mag., which he had hitherto not seen in that place, and which, therefore, was probably a new planet or a variable star. The position for 1800 is,

R.A. $20^h\ 5^m\ 18^s$ N. Dec. $8^\circ\ 30'$

As Dr. Petersen found the star in the same place on August 19, *it is probably* a variable star.

*Extract of a Letter from the Rev. John Slatter, F.R.A.S., Rose Hill, near Oxford, June 26, 1851.**

" There was an occultation of *Jupiter's* fourth satellite on June 20th, at about $16^h\ 30^m\ 30^s$ Sid.Time, Rose Hill, not mentioned in the *Nautical Almanac*. The lowness of the planet prevented my making a satisfactory observation. I estimated that the centre of the satellite would pass about 1″ below the apex of the planet.

" I have made the following observations of *Jupiter* and his satellites :—

Sidereal Time, Rose Hill.

			h	m	s			
1850.								
March	17	1st Sat.	8	25	9	Internal Contact.		Egress of Shadow.
		—		30	4	External	—	
April	17	3d Sat.	10	12	0	Inter.	—	Ingress of Shadow.
	23	1st Sat.	11	14	45	Exter.	—	Ingress of Satellite.
		—		20	45	Inter.	—	
May	9	1st Sat.	11	40	40	Inter.	—	Ingress of Shadow.
June	1	1st Sat.	14	28	28	Exter.	—	Egress of Shadow.
	2	2d Sat.	13	19	46·5	Estim. Centre.		Ingress of Satellite.
		—		22	16·5	Inter. Contact.		
1851.								
June	20	1st Sat.	14	26	37	Estim. Centre.		Ingress of Satellite.
		—		29	55	Inter. Contact.		
		1st Sat.	15	41	33	Estim. Centre.		Ingress of Shadow.
		—		43	38	Inter. Contact.		

The power used in all the observations was 236.

" The following observations were made on the relative brightness of the satellites. To avoid bias, I made a diagram, affixing to each satellite one of the four first letters in the alphabet, and put these down in the order of brightness before consulting the *N. A.* to identify them. The observations were made with full aperture and various powers, generally 120, 180, and 236. The order set down was the result of the scrutiny with all the powers, aided, when possible, by another eye; the judgment of which, taken independently, usually coincided with my own. The result may, therefore, be taken as a pretty accurate expression of what the instrument indicated at the time and place of observation. I must observe, however, that the atmosphere will be found to have a great effect on the observation; any slight haze is sometimes enough to surround the planet with a halo of false light: in this case a high power was sometimes of great service (though higher than the night could bear for purposes of clear vision), in order to separate the satellites far enough from the planet to admit of their being brought into the field for comparison without the planet.

" In thirty-eight days' observations, on twenty-four of which all four satellites were observed, the result was to place the order of

* The telescope at Rose Hill is an achromatic of 4·9 inches' aperture and 7 feet focal length, by Simms, mounted equatoreally.

Latitude of Rose Hill, 51° 43′ 50″ N. Longitude, $0^h\ 4^m\ 56^s\!\cdot\!5$ West.

brightness thus, 3, 1, 2, 4, on fifteen days; 3, 2, 1, 4, on nine days. There did not appear to be any periodicity in the changes of the first and second. In the series there were two instances of the remarkable diminution in brightness which the third always suffers in transiting the disc of the planet. June 6 it is noted as darker than the belts. With these exceptions it was always noted as the brightest. The fourth was always at the bottom of the scale, though noticed as comparatively much brighter at the period of greatest elongation; and this could not arise from contrast with the light of the planet, as the others would have been affected similarly (*e.g.* on the 20th of June last, the fourth and first were noticed at equal distances from the planet; the first much brighter than the edge it was approaching, the fourth remarkably dull). I think it will be found that there is a periodicity in this satellite's brightness answering to the line of quadratures and conjunctions. I only noted one exception to this, 1850, May 10, when all satellites were near *Jupiter*, and the order appeared 3, 4, 1.

"This method of observing by mutual comparison without reference to an absolute standard is, of course, very unsatisfactory, but something might be done by multiplied observations.

"On June 8, 1850, at 10 P.M. I observed a phenomenon which I had never seen before,—the whole of the north pole down to latitude 40° covered with a dark cloud of the same colour as the belts.*

"If, as there is every reason to suppose, *Jupiter* is covered with a gaseous envelope, is it not possible that the belts mark the situations where the ascending equatoreal and polar currents mix, and which may, in consequence, be incapable of reflecting light? The slight inclination of *Jupiter's* axis to his orbit would then account for their permanency."

Elements of the Elliptic Orbit of γ Virginis.

By Isaac Fletcher, Esq.

"The following elements of the orbit of γ *Virginis* were computed by Sir John Herschel's process, described in vol. v. of the Society's *Memoirs*. The observations used in the calculations are those compiled by Sir John in his volume of observations at the Cape, together with those which immediately follow, and which depend on my own determinations.

Epoch	1850·364	Position	176° 40′	Distance	2″·946	Tarn Bank Observations.
—	1851·401	—	175 58	—	3·047	

Elements.

Perihelion Passage	1836·381
Inclination	28° 41′
Position of Ascending Node	19 32
Angle between the Lines of Nodes and Apsides	298 22
Excentricity	0·8876
Period	185·71 years.

"These elements represent the observations very well."

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* An explanatory drawing was sent.

On the Construction of Standard Thermometers. By Mr. Sheepshanks.*

On considering the different stages of a complete and satisfactory solution of the problem which has engaged me so long, viz. how to fix the standard yard, and to multiply trustworthy copies of it, I was very early led to inquire, as a necessary part of my task, into the reliance which could be placed on such thermometers as were in ordinary use or easily procurable. My very constant friend and coadjutor, Mr. Simms, gave me every information in his power; but very frankly admitted that he did not profess to make thermometers possessing the degree of accuracy I seemed to require, and that, to the best of his knowledge, there were no thermometers to be had which would at all come up to my mark. After a little inquiry and some consideration, in which I received much valuable information from Professor Miller, I came to the conclusion that if I wanted to have thermometers on which I could thoroughly rely, I must make them, that is, *graduate* them, myself.

I now proceed to explain the method which I have adopted to produce a standard thermometer; and though the trouble is great, and some doubts perhaps hang still upon a part of the process, I believe I can produce, with tolerable certainty, instruments which, with certain precautions, will show a thirtieth or even a fiftieth of a degree of Fahrenheit. I only require that skill in the workman which is usually to be found, and I do not *depend* upon him at all.

The two forms of thermometers which I graduate are those which have tubes divided into 180 or 120 equal parts; the divisions are bit with fluoric acid on the glass. The divisions which I use are a tenth of an inch apart, and they are drawn on the wax covering the tube by Mr. Simms' straight-line dividing engine. It is desirable, though not strictly necessary, that the divisions should be equal, and it is also desirable that the bore of the tube should be pretty uniform. The maker will, "for a consideration," select the tubes; and it is worth while to pay the additional price, as it saves a great deal of trouble. I do not know whether the circumstance was accidental, but I found some round bores almost perfectly true: this has never been the case with the flat bores. The latter, however, are much more easily read. The flat bore must have no sensible *twist*.

The bulbs should not be very small or very large: I find from three or four tenths to half an inch or a little more in diameter is a convenient size. In my longer tubes, those of 18 inches, I direct the maker to have the freezing-point as near the zero of division as he can safely get it, only it must be *above*.† The boiling-point must also be within the graduations, and the nearer 180^d the better.

* The substance of this account was delivered orally at the June meeting, when the apparatus was exhibited.

† The tubes may be divided before the bulb is blown, but this is not necessary.

I call these, *generating* thermometers; for, as will be seen hereafter, no thermometer is constant in *wide* ranges and at *different* times. The divisions in a well-contrived thermometer of this kind are, of course, rather greater than degrees of Fahrenheit, but not much.

The thermometers which are divided into 120 equal parts may have the freezing-point either high or low, according to their proposed use. For ordinary use, in this climate at least, I should wish to have the freezing-point somewhere about 10 divisions, and to have the 120 divisions equivalent to about 100° of Fahrenheit. I have reason to believe that, even at this temperature, the bulb of the thermometer suffers a small change, which continues for some time, though not permanently. For nice observations at usual temperatures, the freezing-point might be brought very near the zero, and the upper end of the scale made to represent 90°, or even 85° Fahrenheit.* It is better to have special instruments for special purposes, and, if extreme cold is to be measured, to have one instrument for this service.

The first and indeed only essential manipulation to learn, is that of *breaking the column* of mercury. On holding the bulb uppermost, the mercury will run down to the farther end of the tube, and a *vacuum bubble* will show itself on the bulb. If the tube be now quickly and adroitly reversed, the vacuum bubble may be driven into the *neck* of the bulb; and if that is done, a slight tap when the thermometer is horizontal will break off the column of mercury *at the neck* of the bulb. With a little practice this trick is easily learned, and by warming or cooling the bulb, the length of the column to be broken off can be adjusted very nicely to what the experimenter requires. By repeated trials, I can always break off a column to a quarter of a division, or even closer; but this accuracy is more than sufficient, if the tube is pretty regular.

The column should *unite* again, by holding the tube inclined and the bulb downwards; or the mercury may be driven from the bulb to the other end by a smart stroke on the palm of the left hand, with that end downwards, while holding the thermometer in the right, bulb uppermost. If now the bulb be lowered, keeping the vacuum bubble *out* of the neck, the column should unite.

From some causes which I cannot explain—perhaps from little irregularities at the neck of the tube, foulness or imperfection in the tube itself, or impurity in the mercury—it frequently happens that the mercury will either not *break*, or will not *unite*, as it should do. I should recommend the rejection of a thermometer, *for the purpose of a standard*, where these contradictions are frequent, and where the instrument seems refractory. But I have always been able, in the end, to obtain my purpose, though sometimes at a considerable expense of time and temper.†

* A small chamber is or may be contrived at the top of the tube, to prevent breakage by extraordinary expansion.

† Bessel seems not to have known this art of breaking the column, for which I am indebted to Mr. Frankum. Bessel's plan of separating the column by the *flame of a lamp* is very unsafe. There is the pressure of an atmosphere on the

Supposing this manipulation acquired, and a tractable thermometer provided, having a division upon the glass stem to 180 or 120 equal parts, I proceed as follows. First, with the tube having 180 divisions I break off a column, which, when the tube is horizontal, reaches from 0^d to about 90^d; let us suppose to $89^d{\cdot}4$. I now bring one end of this column to 180^d, and read the other, which suppose $89^d{\cdot}8$. As the same mercury is used in the two measures, it is clear that the *capacity* of the tube from 0^d to $89^d{\cdot}4 =$ the capacity from $89^d{\cdot}8$ to 180^d, or that the mean of the two readings $89^d{\cdot}6$ will be the point which bisects the capacity of the tube from 0^d to 180^d. As $89^d{\cdot}6$ on the tube in question would be expressed by 90^d on a *perfectly equal* tube, the *correction* to $89^d{\cdot}6$ or to 90^d is $+0^d{\cdot}4$.*

The *length* of the column, *i. e.* the length it would occupy if the tube were uniform, is $0^d{\cdot}2$ short of half-way, or is $= 89^d{\cdot}8$.

Before proceeding to a new breaking of the column, I carry one end of the present column to 60^d, and read the other somewhere near 150^d; and after that one end to 120^d, and read the other near 30^d. The use of these will be seen immediately. I now cool the bulb, if necessary, and break off a column which is about equal 60^d, and this I carry forward at three steps from 0^d to 180^d, *i. e.* I make one end fall successively on 0^d, 60^d, and 180^d, and read the other end.

It is clear, that if the error of the division of 60^d tends to lengthen or shorten the first of these measures, it will tend to shorten or lengthen the second of these measures, and in like manner the error of the division of 120^d will have *contrary* effects on the second and third measures; that is to say, the *sum* of the three measured lengths will not be affected by an error in the divisions 60^d and 120^d, and therefore the *mean* will give the true length of the column, in parts of a *perfect* tube of the same capacity. Suppose this mean to be $60^d{\cdot}3$, then the difference of the end of the first reading from $60^d{\cdot}3$ will be the correction to 60^d, and the difference of the third reading from $180^d - 60^d{\cdot}3$, or $119^o{\cdot}7$, will be the correction to 120^d. These readings, as well as the former, should be repeated until there is no doubt of their exactness. I now carry the column forwards and backwards from 90^d, and read the ends towards 30^d and 150^d.

softened glass, which, without caution, might strangle the tube. When the column is broken above the neck of the bulb, sometimes a union may be effected by turning the whole body of mercury up and down, backwards and forwards. Sometimes the bulb may be cooled, so that the separation enters into the bulb and becomes obliterated. By heating the bulb and cooling it, the larger mass will seem to lick up the fragment. This last process is of no importance while dividing the thermometer; but as heat above 100° will disturb for a time the freezing-point of an established thermometer, this mode of uniting the column is only to be resorted to in case of necessity, and the thermometer should be laid aside for some time to return to its original state.

* On the supposition that the tube is correct enough to permit the assumption that the error *near* 90^d does not sensibly differ from the error *at* 90^d. This assumption is made throughout: but if the tube is very unequal, special precautions must be resorted to.

Now the *true* value of 90^d being known, viz. $90^d \cdot 4$, and the true length of the column of 60^d being also known, viz. $60^d \cdot 3$, it is clear that the *true* value of the other ends of the column, after the column of 60^d has been carried backwards and forwards from 90^d, will be $90^d \cdot 4 - 60^d \cdot 3$ and $90^d \cdot 4 + 60^d \cdot 3$, or $30^d \cdot 1$ and $150^d \cdot 7$; and as the *actual* readings are known, the difference from the *true* values will give the *corrections* of 30^d and 150^d. In like manner, since the *corrections* of 60^d and 120^d are known, and the value of the column of 90^d is also known, the column of 90^d carried back from 120^d and carried forward from 60^d will give the *true* values of 30^d and 150^d, and, when compared with the *actual* readings, will give the *corrections* of those two divisions. Consequently, the *corrections* of the divisions 30^d and 150^d are given by two independent methods; and if these agree well, the *mean* must be correct. If there is any discrepancy, the operations must be repeated *toties quoties*, until a satisfactory conclusion is arrived at, though with moderate care and a steady temperature* no error should occur.

I now break off a column of 50^d and ascertain its *true* length, *i. e.* what it would measure in a perfect tube of the same capacity, by carrying it thrice from 0 to 150^d and thrice from 30^d to 180^d (the corrections of 150^d and of 30^d have already been ascertained). If these two values of the length agree, I have got, just as with the column of 60^d, the errors of 50^d and 100^d, and of 80^d and 130^d. I now carry this column backwards from 60^d, which gives me the error of 10^d; backwards from 90^d, which gives me that of 40^d; backwards from 120^d, which gives me that of 70^d; forwards from 60^d, which gives 110^d; forwards from 90^d, which gives 140^d; forwards from 120^d, which gives 170^d. There are now only two of the decades missed, viz. 20^d and 160^d. These are got by carrying 50^d backwards from 70^d and forwards from 110^d, but as these are derived secondarily, it is prudent, in a former stage, to carry the column of 60^d backwards from 80^d and forwards from 100^d. If the two independent values agree nearly, a mean may be taken, and there can be little doubt of the result.

By breaking off a column of 45^d and carrying it four times along the whole distance from 0^d to 180^d (or from the two extremes and from 90^d), its *length* may be obtained. Carrying this backward from 50^d, 60^d, &c. the corrections of 5^d, 15^d, &c. may be ascertained, and by carrying it forwards from 0^d, 10^d, 20^d, &c. the corrections of 45^d, 55^d, 65^d, &c. are obtained. The corrections of the divisions into fives from 45^d to 135^d are thus got twice over, and independently, which is a great confirmation, and the accuracy of the mean is much increased.

When the tube is tolerably good, *i. e.* when the errors of the divisions follow a sort of law, I have found a careful interpolation of the corrections of the tens sufficient, without actually measuring

* The expansion of the column at first frequently plagued me; but when this was allowed for I have had no trouble, except from mere blunders of reading off, *or in arithmetic.*

those of the fives. This is a great saving of trouble, and can scarcely mislead, if from each ten the interpolation is made for the preceding and succeeding five.* Should the double values agree pretty well, the mean cannot be far wrong.

When the tube is divided into 120 parts, the only difference is, that the columns first broken off are of 60 and 40 divisions respectively: by means of these the corrections of 60^d and of 40^d and 80^d are first obtained, and also the corrections of 20^d and 100^d. The length of the column of 50^d, which is now broken off, is ascertained by carrying it at twice from 0^d to 100^d, and again by carrying it at twice from 20^d to 120^d; thus the errors of 50^d and 70^d are determined. With the known length of the column of 50^d and the known corrections of 40^d, 60^d, and 80^d, the corrections of 10^d, 30^d, 90^d, 110^d, 130^d, are determined. If an interpolation leaves some uncertainty as to the divisions into fives, a column of 45^d is run through the whole tube by steps of five divisions. The *length* of this column is derived from the known errors of 0^d and 90^d, of 10^d and 100^d, of 20^d and 110^d, and of 30^d and 120^d; and with this value and the known corrections of the decades, those of the pentades are deduced.

If the observer is careful to assure himself that each stage of the operation is correct before proceeding to the next (and the verifications almost force themselves upon him), the work will proceed to the end without any vexatious harking back. The subdivision can be carried below the fives, but this is scarcely ever necessary. It is better to reject a manifestly imperfect tube than to employ so much time as would be necessary to correct each

* I scarcely know whether the mode of interpolation is commonly known; I made out the formula more than twenty years ago, and have used it with great satisfaction. The quantities to be interpolated are written in a vertical column, and the differences taken as usual. The *interpolating* coefficients for each of the original quantities is computed as follows:—

A = $\frac{1}{2}$ sum of 1st differences above and below the horizontal line.
  − $\frac{1}{12}$ sum of 3d differences — — —
  + $\frac{1}{60}$ sum of 5th differences — — —
B = $\frac{1}{2}$ 2d difference on horizontal line.
  − $\frac{1}{24}$ 4th difference — —
C = $\frac{1}{12}$ sum of 3d differences above and below the horizontal line.
  − $\frac{1}{48}$ sum of 5th differences — — —

which are sufficient for most purposes; then if $\mp x$ be the required fraction of an interval above or below one of the original quantities as M,

$$\text{for } -x \text{ the interpolated value} = M - Ax + Bx^2 - Cx^3$$
$$+x \quad \text{—} \quad \text{—} \quad = M + Ax + Bx^2 + Cx^3$$

the interpolation where $x = \frac{1}{2}$, or $\frac{1}{4}$ or 0·1, 0·2, &c., is very rapidly performed, and the checks so satisfactory, that error can scarcely creep in.

single division, though I have done it very satisfactorily in a tube which had a manifest strangulation at one part.

I have described the process as it may be conveniently performed *by eye*, and it is desirable to examine each tube in this way, even when a more careful determination is proposed. I do not think that by mere estimation a tube can be divided with greater accuracy than 0·1 div., though this will depend on the observer. But even this degree of accuracy is beyond what is found in many standard thermometers, and such an examination costs very little time, not, I think, so much as half an hour.

In dividing my own thermometers, I have always read off each end of the column by a short telescope, which is carried by a slide parallel with the tube, the tube itself resting horizontally in two notches. I find the indistinctness of the end of the mercury and the division on the glass is not troublesome, when the distance from the tube to the object-glass is about four times that from the object-glass to the image. If the telescope is not longer than 5 inches, the tube can be touched without disturbing the observer. The micrometer should have a large divided head, and one revolution of the micrometer should correspond nearly to one division on the tube. Thus hundredths of a division are read at once from the micrometer, and thousandths may be estimated.* By moving the telescope nearer to and farther from the object, and by pulling out and pushing in the eye-piece, it would be easy to adjust the micrometer revolution to the division of the tube; but tubes are seldom quite straight, and I find it best to place the fine wire (which is used for observing the end of the column and the preceding and succeeding divisions) upon the division preceding the end of the column by a slow motion in the slide, when the micrometer reads 0; the fine wire is then carried by the micrometer to touch the end of the column, and afterwards to split the succeeding division, both of which readings must be noted. The observations are then repeated and noted, moving the micrometer backwards. Taking for the true reading the mean of the forward and backward readings in each case, the difference of the readings of the preceding division and of the end of the mercury, divided by the difference of the readings of the two divisions, gives the decimal of a division required. A short table of double entry will save trouble in computing when the adjustment is tolerably nice. The remaining computation is the same as in the eye estimation.

An example of the calculation of the errors of every ten divisions in a thermometer graduated to 120 equal parts, will show the operation better than any mere description.

* In my own apparatus, the screw is too fine and the telescope too long, so that a good deal of time is lost in making the observation and in computing the decimals of the division. One division on the tube corresponds to four revolutions of the screw, so that there is a chance of setting down a wrong number of revolutions, a chance which not unfrequently happens.

The readings of the divisions corresponding to the ends of the column, reduced from the micrometrical observations, are as follows:—

Column = $60^d \pm$.

d	d	d	d
− 0·294	60·118	19·628	39·900
60·276	119·706	79·777	99·811

Column of $40^d \pm$.

d	d	d	d	d
0·136	40·147	80·390	19·806	60·212
40·111	79·653	119·600	59·590	99·530

Column of $50^d \pm$.

d	d	d	d	
− 0·060	50·218	20·139	70·435	
49·982	99·524	69·852	119·559	
d	d	d	d	d
10·209	30·125	40·177	60·299	80·343
60·088	79·682	89·612	109·511	129·374

The − signifies that the end of the column is below the zero.

The operation is nearly the same throughout. The *length* of the column, *i.e.* that which it would occupy in a *perfect* tube of equal capacity from 0^d to 120^d, is first determined; and this column, having one end near a division which has no correction or a known correction, measures the error and correction of the division near its other end.

Apparent values of column of 60 ±	= 60·570	By first pair of observations of 60 ±.
	= 59·588	
Mean or *true* value of col.	= 60·079	

Apparent values of column of 40 ±	= 39·975	By first three observations of 40 ±.
	= 39·506	
	= 39·210	
Mean or *true* value of col.	= 39·564	

Correction of 60 Division.

Reading of *known* end	− 0·294	119·706	
True length of column	+ 60·079	− 60·079	
Actual value of other end	59·785	59·627	*i.e.* what each *should be.*
Corresponding reading	60·276	60·118	
Correction to 60^d	− 0·491	− 0·491	for scale of equal parts.

Correction of 40 and 80 Divisions computed.

Reading of *known* ends	0·136	119·600
True length of column	+ 39·564	−39·564
Actual value of other end	39·700	80·036
Corresponding reading	40·111	80·390

Correction to 40^d = −0·411 to 80^d = −0·354

The middle pair of readings may be used to check these corrections.

Corrections of 20 and 100 Divisions computed.

	By Column $60^d·079$.		By Column $39^d·564$.	
Readings	79 777	39·900	59·590	60·212
Corrections	−0·354	−0·411	−0·491	−0·491
True value	79·423	39·489	59·099	59·721
Column	−60·079	+60·079	−39·564	+39·564
Actual value	19·344	99·568	19·535	99·285
Corresp. reading	19·628	99·811	19·806	99·530
Corrections	−0·284	−0·243	−0·271	−0·245

The means may be taken, though the corrections of 20^d are not satisfactory. We have,

$$\text{Correction} \quad 20 = \overset{d}{-0·277}$$
$$100 = -0·244$$

These are the first or fundamental corrections, and the observer must not proceed until these agree satisfactorily.

Length of column 50± computed.

The readings of 100 and of 20 being corrected according to what has just been found, we have, for *apparent* values of this column,

$$\text{First pair} \left\{ \begin{array}{l} 49·982 + 0·060 = \overset{d}{50·042} \\ 99·280^* - 50·218 = 49·062 \end{array} \right\} \text{Mean} = \overset{d}{49·552}$$

$$\text{Second pair} \left\{ \begin{array}{l} 69·852 - 19·862^* = 49·990 \\ 119·559 - 70·435 = 49·124 \end{array} \right\} \text{Mean} = 49·557$$

The *length* may be safely assumed = $49^d·554$.

* These values are *corrected* for the errors of 100^d and of 20^d.

Corrections of 50 computed.

Reading	$= -0^{\cdot}060$	Reading	$99^{\cdot}524$
Column	$= +49^{\cdot}554$	Correction	$-0^{\cdot}244$
Actual value	$49^{\cdot}494$		$99^{\cdot}280$
Corresp. reading	$49^{\cdot}982$	Column	$-49^{\cdot}554$
Correction	$-0^{\cdot}488$	Actual value	$49^{\cdot}726$
		Corresp. reading	$50^{\cdot}218$
		Correction	$-0^{\cdot}492$

Mean or correction of $50^{d} = -0^{\cdot}490$.

In like manner the corrections of $70 = -0^{\cdot}436$ and $-0^{\cdot}430$; mean $= -0^{\cdot}433$.

Now, *correcting*, in the remainder of the readings of 50, those which are known already, and adding or subtracting $49^{d\cdot}554$, we shall have the *true* values as well as the actual readings, and the following corrections will be found :—

	d	d
For	10	$-0^{\cdot}166$
	30	$-0^{\cdot}351$
	90	$-0^{\cdot}292$
	110	$-0^{\cdot}149$
	130	$+0^{\cdot}169$

On writing the whole series down and taking the differences, it appears that interpolated values of the fives agree pretty well whether they are derived from the preceding or succeeding ten. If not, or if I wished to be *quite certain*, a column of 45^{d} must be broken off and treated as before directed.

I like to have the two ends of the mercury nearly symmetrically placed with respect to the divisions which are to be corrected; but if the tube is tolerably even, no sensible error is likely to arise from slight neglect.

It has been assumed that a column of 40 divisions can be broken off, and this is almost always practicable with the generating thermometers, unless the freezing-point is very high. But in the other thermometers, it is not always possible to get so short a column, except in winter. Temporary means, such as dropping ether on the bulb, may be resorted to at times, but the inconvenience is considerable; a set of observations may be easily lost by the junction of the mercury, and the temperature and consequently the length of the column is variable. If a thermometer were required to show severe cold, I should *graduate* the tube with a smaller amount of mercury. The bulb might then have the proper supply of mercury added, or a fresh bulb might be blown and filled; the *graduation* of the tube is not affected. The same course must be pursued if a bent tube thermometer is wanted; at least I should despair of graduating such a tube, owing to the difficulty of breaking and

uniting the column,* though perhaps a more persevering experimenter would succeed.

It will be seen, that though I have explicitly laid down the necessity of having the divisions cut upon the tube itself, there is nothing in the directions here given which might not be applied to divisions on a *scale*. But a thermometer so mounted is far more dangerous and difficult to manipulate, and there is a perpetual risk that the relative position of the tube and the scale may be altered. For most purposes, the usual form is sufficient and more convenient; but the object I have had in view was to obtain the utmost attainable accuracy with the least probable risk, without regard to the trouble of the maker or of the future experimenter.

The illustrious Bessel has given in Poggendorff's *Annalen*, vol. lxxxii. p. 287, an account of the method he employed to verify his standard thermometers. I own that I very much prefer my own method, which is, I think, more systematic and more certain, checking itself as it proceeds. I made trial of Bessel's plan with respect to a thermometer which had its freezing-point too high for my mode of operating, and got very fair results. Something of his mode may be applied thus:—In a thermometer which has had its principal divisions *measured* as above described, and the errors of the other divisions assigned by *interpolation*, break off a column *ad libitum* and carry it at certain intervals from one end to the other of the tube. Determine the mean *length* of this column, using the interpolated values of the errors of the divisions, and then this known length and the *measured* divisions will give safe values for the errors of the other divisions.

The thermometer being thus carefully subdivided, and I think it practicable almost to insure the second decimal, the next thing is to ascertain the freezing and boiling-points of the *generating* thermometers. It has been known for some time that in a new-made thermometer, which is usually sealed hermetically while the mercury is boiling, a considerable time must elapse—six months or thereabouts—before the bulb arrives at its permanent dimensions. It has not been as yet worth my while to ascertain the exact amount of this *contraction*, as my concern has only been with the points of *freezing* and *boiling* water, but it is necessary that this *retraite*, as it has been called, should have taken place before any exact experiments are made to determine the fundamental points of the thermometer. The graduations may, of course, be examined and corrected previously.

I determine the freezing-points by laying the thermometers *horizontally* in pounded ice, *which is carefully drained.* I have hitherto used the ice which was found on some tubs filled with

* Of four thermometers which had their tubes bent after graduation, two were quite useless, as the mercury always broke at the neck when the temperature was lowered. Two others fared better, and have rendered me excellent service in testifying to the temperature of the mercurial trough in which my standard bars are suspended and supported, with an almost perfect agreement.

rain-water, and I found experimentally the same results precisely from this ice and from new-fallen snow.* But I propose to use the ice of Wenham Lake in my future determinations. It is so much more convenient to perform the manipulations when the ice is melting very slowly, that I should not willingly determine freezing-points except in winter. To make sure that the ice is not *below* the freezing-point, it is kept in a vessel with water in a room above the freezing-point. The ice is very lightly heaped over the bulb; care must be taken to avoid any pressure, and the *horizontal* tube is read with a *vertical* telescope. It is more easy to prevent the possibility of *parallax* this way than in any other which can easily be put in practice; and unless the experimenter is very careful as to the dryness and light pressure of the ice, the horizontality of the tube, and the verticality of the reading telescope (which I need not say is fitted with a micrometer, and is used exactly as has been described already in reading the divisions), the results will be far less accordant and satisfactory than they might be.

The settling the boiling-point is not so easy as that of the freezing-point, and at first I utterly despaired of getting anything like a trustworthy determination; but working, and I think improving, on Professor Miller's instructions,† I at last succeeded even beyond my expectations.

My boiler is made of sheet copper, square above and cylindrical below; the dimensions, which are not very material, are, length 24 inches, breadth and depth about 6 inches, with flat ends and top. In one end there is a round hole, fitted with a large cork; through the centre of the cork a small pipe of copper pierces, large enough, however, to allow the thermometer tube to pass: a bar, stretching across the inside of the boiler, at the same height nearly as the centre of the cork, supports the thermometer near the bulb, when the cork (thermometer and all) is inserted pretty tightly in its hole. As much of the tube of the thermometer is exposed as will show the division below the boiling-point; and the joint between the tube and the pipe, which projects a little, is made good with a binder of very thin vulcanised India rubber. Distilled water is poured into the boiler, but not so much as to touch the thermometer, which is thus boiled in steam. There are some round holes in the flat top which can be closed sufficiently by flat pieces of brass, and the mounting of the boiler admits of applying two or three spirit-lamps below, which are sufficient to bring it to a pretty smart boil.

When the steam rises strongly, the flat pieces on the top of

* Snow and ice must both be carefully drained, and both should be melting. When the snow or ice is wet the freezing-point stands too high.

† I have always applied to my colleague, Professor Miller, for the information, formulæ, &c., which I required; and have only had to select from the abundant store which he has forwarded me. I beg here to thank him, even more for the readiness and heartiness with which he has assisted me than for the assistance itself, valuable as it has been.

the boiler begin to chatter, and it is certain that the necessary heat, at least, is attained. By removing one, two, or three of the flat pieces, it will be found that in a little time the position of the mercury becomes steady, and is not affected by closing one of the holes or unclosing another. This steadiness of the boiling-point, whether the steam issues languidly or with considerable vehemence, is rather a puzzle to me, but the fact is quite certain.

A measure of the reading which corresponds to the end of the mercury (by telescope and micrometer as before), and a reading of a standard barometer (with its attached thermometer), the cistern of which is on a level with or at a known height above or below the boiler, give, by a formula, that reading of the boiling-point which corresponds to a pressure of 30 inches, or any other pressure that may be assumed. I propose, however, to determine the relation of the boiling-point at different pressures experimentally.

Two or three cautions must be observed. The boiling must continue a little time, as I think I have observed, to allow the bulb to arrive at its full expansion. The water must not be allowed to get too low, or the flame may heat the boiler *above* the water; and in that case the apparent boiling-point of the mercury will begin to rise.* Lastly,—the caution cannot be too often given,—the line of sight of the telescope must be perpendicular to the tube at the boiling-point, very nearly, or the plague of parallax, no small plague if the tube is thick, will come in.

In contriving my own apparatus I added an appendage, which is certainly satisfactory to a scrupulous observer, though I have scarcely derived any other advantage from it, viz. a steam-gauge in the other end of the boiler, which is thus out of the way of the thermometer and its cork: the gauge is inserted above the water-mark, and so contrived that the steam as it condenses flows back into the boiler. By placing rings to touch the two surfaces of the mercury in the gauge when the water is not boiling, or when all the holes are open, it is easy to satisfy yourself that there is no pressure when the boiling-point is noted, although the steam may issue with considerable violence.

If now, without loss of time, the thermometer thus boiled be placed in ice as before, and the freezing-point ascertained, it will be found to have fallen rather less than $0^{\circ}\cdot 3$ Fahrenheit.† The freezing-point rises, however, very rapidly—a very sensible quantity in 24 hours—but I cannot say how long a time it takes to resume its former stand. I am pretty sure that it does return exactly, in time; at least my observations hitherto agree to confirm this

* This happened to me once, and rather alarmed me, till I made out the cause. There are many ways—by balance, for instance— of ascertaining the quantity of water. I have applied a tube, bent upwards, which is inserted below the water-mark, through which I can also feed the boiler; but I have not yet used it.

† This, at least, has been constantly the case with me when the thermometers had been long enough made to have come to a steady stand before determining the freezing-point.

opinion; though I have heard from an eminent foreign maker that he does not find quite the same thing.

I will here venture to throw out a hypothesis, which I do not remember to have seen suggested elsewhere, and which I propose to examine as soon as I have time; viz. that the law of expansion is not so simple as has been generally supposed, but consists of two terms. One of these simply depends on the temperature of the body at the time; the other is a function of the highest temperature to which the body has been elevated, and the time since elapsed. There are several anomalies which I have seen, or heard of, which might, I think, be solved by this law, if it should turn out to be a true one. There is, too, some analogy with a well-known fact, that a piece of metal which has suffered violent constraint, such as hammering, rolling, &c., has a tendency to relieve itself, as it were, in time. I believe that some of the great variations which seem to have taken place in our standards of length may be referred to one or other of these causes; the lengths have been set out on bars too recently cast, or forged; or the metal, having been constrained by rolling or drawing, has struggled to release itself after the division.*

To return, however, to the thermometers. Having got contemporaneous freezing and boiling-points, and the errors of the divisions, I find the degree of Fahrenheit which corresponds to each tenth or fifth degree, and interpolate for the rest. After a considerable time I determine the freezing-point anew, which should agree with the *first* value, and add the proper correction to the table, if already formed, or use it in forming my table of equivalents of Fahrenheit.

If I am right in my belief, that the freezing-point of an old thermometer begins to fall even at so moderate a temperature as 100° Fahrenheit, it is clear that a *standard* thermometer, in the common acceptation of the words, *i.e.* a thermometer which will correctly indicate all temperatures from freezing to boiling, is not to be had, except the thermometer be boiled just before every observation,† when, alone, if I am right, the thermometer is correct at all temperatures below boiling.

For the ordinary usage of a standard thermometer, *i.e.* marking with great exactness all temperatures from a little below freezing to our greatest summer heats, I prefer using a well-seasoned thermometer divided into 120. The freezing-point is determined as before, and a point between 70° and 80°, or thereabouts, from a comparison with several *generating* thermometers, which have come to a steady freezing-point. By placing the thermometers in a box of water, and comparing with several generators, using the precau-

* The process of annealing might, perhaps, cure this restlessness in the particles of metal; but time would still be required, if this hypothesis be true, before the mass took up its final and permanent *stand.*

† This would be necessary in measuring the heat of hot springs, if 0°·1 or 0°·2 be sensible in such observations.

tions so often described, it is, I think, possible to get an upper point with sufficient accuracy.* A table, assigning the corresponding values of Fahrenheit, is to be constructed for each thermometer; and these, I should hope, would be truly *standards*, within the limits for which they are designed. A verification of the freezing-points, after a considerable time, would be all that could be wanted to entitle them to perfect confidence. In this way, by the use of two forms of thermometer, it seems to me that all temperatures up to boiling-water may be estimated. It is indeed possible that an extreme degree of cold may alter the freezing-point, but a mixture of salt and snow did not do so; though I own the experiment was carelessly made, not belonging particularly to the subject on which I was and am engaged.

I assume that the thermometer tube is horizontal. In a well-made instrument the mercury will not break at the neck or run to the other end, unless the tube be considerably inclined downwards, and my concern is only with the best tools and the best mode of using them. There is this objection to placing the thermometer upright, that the pressure on the interior of the bulb, when the column is long, enlarges the bulb very sensibly, and so causes the mercury to stand *lower* than it should do. In some thermometers with large thin bulbs, I think that the difference of reading between a horizontal and vertical position is at least half a division. But as in many cases a thermometer *must* stand upright, its errors, when upright, should be determined by comparison with a standard thermometer arranged horizontally. If this were carefully done, at a high and low temperature, the correction due to this cause for the upright thermometer might be applied to the tabular errors or table of equivalents. Perhaps, with care, a thermometer might be compared with itself, in the two positions; by continuing the observations alternately for some time, the effect of small changes of temperature would be eliminated.

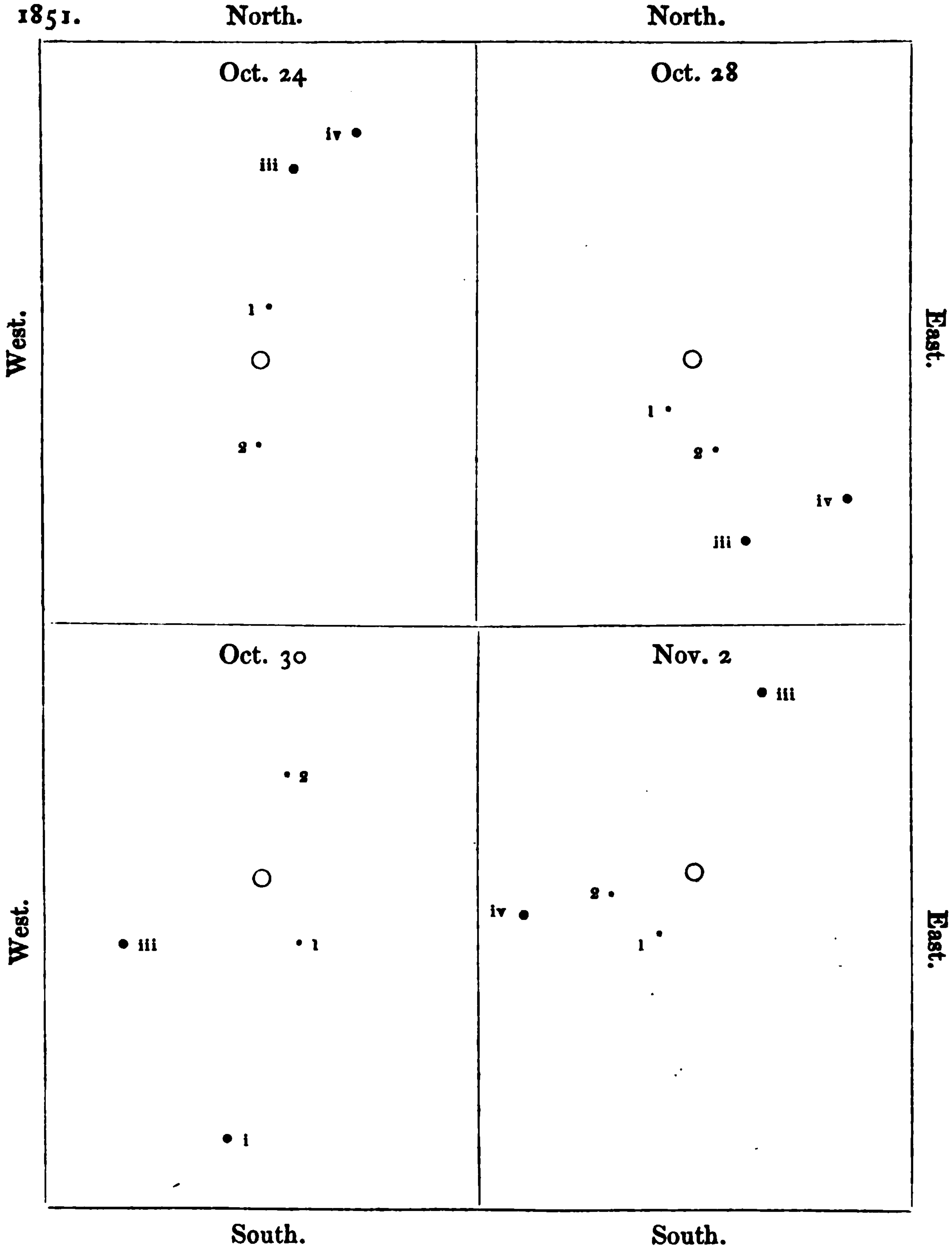
I conceive that all *nice* thermometrical observations should be made by telescope and micrometer; the telescope should move on a graduated bar, so as to prevent the possibility of parallax. If this refinement is thought needless, a reading lens may be slipped along a coarsely-graduated rod, when the reading will be free from all uncertainty except that of estimation.

It is obvious that, for most purposes, a thermometer which requires the use of a special table, of a specially-mounted telescope, and of a microscope, will not be required. I conceive, however, that a standard thermometer would always be useful as a check upon commoner instruments. To accompany the standard yard they are absolutely necessary, and I hope to fit out each yard with its ther-

* I compare with four, five, or six generators, and take a mean. The generators are perfectly independent, and any small errors in measuring the divisions or fundamental points probably nearly compensate each other. The water should be at the temperature of the room.

mometer. Whether it will be worth my while, or that of any other person, to make more than are wanted for this purpose, there is no need to consider at present. Perhaps one might be useful to a scientific-instrument maker, or in an observatory, for the purposes of regulation. I do not know whether in other physical researches, an accurate, but from its mass sluggish, thermometer is wanted, but I should think it probably would be useful in ascertaining the range and scale of more sensitive indicators.

Diagram of Uranus and his Satellites as seen by Mr. Lassell with his 24-inch Newtonian Reflector, equatoreally mounted.



The large dots *iii and iv are the* two bright satellites from which the positions of *the new satellites* were generally estimated or measured.

Extract of a Letter from Mr. Lassell, dated Nov. 3, 1851.

" I am now quite able to announce to you my discovery of two new satellites of the planet *Uranus.* I first saw them on October 24th with a strong persuasion that they were really attendants on the planet, and obtained further observations of them on the 28th and 30th of October and also last night. The observations are all perfectly well satisfied with a period of revolution of almost exactly four days for the outermost, No. 2, and 2·5 days for the closest, No. 1. They are therefore both considerably within the nearest of the two bright satellites, and even within Sir William Herschel's *first* satellite, to which he assigned a period of about 5 days 21 hours, but which satellite I have never yet been able to recognise.

" These new satellites are very faint objects, probably much less than half the brightness of the conspicuous ones, and generally the nearest has appeared the brightest. All four were steadily seen at one view in the 20-foot equatoreal with a magnifying power of 778 in the more tranquil moments of the atmosphere. The finest definition of the planet and freedom from all loose light in the field of view, is necessary for the scrutiny of these most minute and delicate objects."

ERRATA ET CORRIGENDA.

Omitted, page 1,

EGERIA.

South Villa. (MM. Bishop and Hind.)

1850.	Greenwich M.T. h m s	R.A. h m s	Dec. ° ′ ″
Nov. 12	9 52 5	1 51 21·87	+8 17 10·6
14	6 27 3	1 49 35·09	+8 21 28·3

Of about 9.10 mag.

Page 73, line 18, *for* Woolgar, *read* Woollgar.

— 64, — 12, — altitudes, — altitude.

— 63, — 3 from bottom, *for* 0·137, *read* 1·137.

— — last line, — 0·720, — 1·720.

R.A. of Weisse xxi. 937, is 1^m in defect.

Astron. Nachrichten, No. 760, Berlin observations of *Irene*, *for* May 14 and 16, *read* 24 and 26.

— 187, line 9 from bottom, *for* 5·4, *read* 5.4

— — 4 — — 5·6, — 5.6

— 188, — 1 from top, — 3·4, — 3.4

— — 4 — — 3·4, — 3.4

— — 11 — — 3·2, — 3.2

— 196, — 1 — — case, — ease.

INDEX.

ERRATUM.

P. 247, diagram of Satellites of *Uranus*, at the bottom of left-hand section, *for* • i *read* • iv

London :—Printed by G. Barclay, Castle St. Leicester Sq.

APPENDIX II.

CONTAINING

Presents received during the Session 1850–51.

Académie des Sciences, Comptes rendus hebdomadaires, 4to., vol. xxix., 1849; xxx., xxxi., 1850; xxxii., 1851. *Paris, V.Y.*	L'Académie des Sciences.
Africa. Renseignements sur la Partie de la Côte occidentale d'Afrique comprise entre le Cap Négro et le Cap Lopez, 8vo. *Paris,* 1849	Dépôt Général de la Marine.
Airy (G. B.), Suggestions to Astronomers for the Observation of the Total Eclipse of the Sun on July 28, 1851, 8vo.	The Author.
American Philosophical Society, Proceedings, vol. v., Nos. 43–45. 8vo. 1850–51	The Society.
——— Academy of Arts and Sciences, Memoirs, New Series, vol. iv., Part I., 4to. *Cambridge and Boston, U.S.,* 1849	The American Academy.
——— Proceedings, vol. ii., 8vo.	———
Annales Hydrographiques, tomes ii., iii., 8vo. *Paris,* 1849	Dépôt Général de la Marine.
Annuaire des Marées des Côtes de France pour les ans 1849–50–51, 18mo. *Paris, V.Y.*	———
Architect, The, Nos. 65 to 186, folio. *London,* 1850–51	The Editor.
Asiatic Society (Royal), Journal of the, vols. xi., xii., 8vo. *London, V. Y.*	———
——— Journal of the Bombay Branch, vol. iii., No. 12, 8vo. *Bombay,* 1849	———
Astronomical Journal, various Nos., 4to. *Cambridge, U.S., V.Y.*	———
Astronomische Nachrichten, Nos. 678 to 760, 4to. *Altona,* 1850–51	The Editors.
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The Association.	Bank of England Library and Literary Association, Catalogue of the, 8vo. *London*, 1851
Dépôt Général de la Marine.	Bayonne. Instruction pour aborder et franchir la Banc de Bayonne, 8vo. *Paris*, 1850
	Beke (C. T.), Reasons for returning the Gold Medal of the Geographical Society of France, and for withdrawing from its Membership, 8vo. *London*, 1851
S. M. Drach, Esq.	Berlin. Miscellanea Berolinensia ad incrementum Scientiarum ex scriptis Societate Regiæ Scientiarum exhibitis edita .... 4to. *Berlin*, 1710
Mr. J. Williams.	—— Recueil de Tables Astronomiques publiées sous la Direction de l'Académie Royale des Sciences et Belles Lettres de Prusse, 3 vols. 8vo. *Berlin*, 1776
Prof. Encke.	—— Astronomisches Jahrbuch für 1852–53, 8vo. *Berlin*, 1849–50
The Academy.	——Abhandlungen der Königlichen Akademie der Wissenschaften, 1847–48, 4to. *Berlin*, 1849–50
——	—— Monatsbericht der, July 1848 to June 1850, 8vo. *Berlin*, 1848–50
The Author.	Biot (J. B.), sur le Rapport présenté par l'Astronome Royal à la Commission de Surveillance de l'Observatoire de Greenwich, le 1re Juin, 1850, 4to. *Paris*, 1850
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The Hon. East India Company.	Bombay. Observations made at the Magnetical and Meteorological Observatory, 1846–47, 4to. *Bombay*, 1849–50
Rev. R. Sheepshanks.	Bremiker (C.), Nautisches Jahrbuch oder Vollstandige Ephemeriden und Tafeln fur das Jahr, 1852, 8vo. *Berlin*, 1850
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Cambridge Mathematical Problems and Examples, arranged according to Subjects from the Senate-house Examination Papers, 1821 to 1836 inclusive; with an Appendix, containing the Senate-house Questions for 1837, similarly arranged, 8vo. *Cambridge*, 1837 — S. M. Drach, Esq.

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The Author.	Clare (Peter), An Account of some Thunderstorms and extraordinary Electrical Phenomena that occurred in the Neighbourhood of Manchester on Tuesday the 16th of July, 1850, 8vo. *London*, 1850
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——— for 1752, 12mo. *London*, 1752	J. W. Woolgar, Esq.
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The Author.	Maury (M. F.), On the probable Relation between Magnetism and the Circulation of the Atmosphere, 4to. *Washington*, 1851

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Müler, Nicholas, Tabulæ Frisicæ Lunæ Solares Quadruplices à fontibus Cl. Ptolemæi, Regis Alfonsi, Mich. Copernici et Tychonis Brahe recens constructa, 4to.	*Alcmar*, 1611	Mr. J. Williams.
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A Drawing of the Planet *Saturn*. — W. De la Rue, Esq.

————————————, framed and glazed. — Rev. W. R. Dawes.

A Print of the Royal Observatory, Greenwich. — The Engraver.

An Engraved Portrait of Sir Isaac Newton. — Rev. R. Sheepshanks.

MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY,

CONTAINING

PAPERS,

ABSTRACTS OF PAPERS,

AND

REPORTS OF THE PROCEEDINGS

OF

THE SOCIETY,

FROM NOVEMBER 1851, *TO JUNE* 1852.

VOL. XII.

BEING THE ANNUAL HALF-VOLUME OF THE MEMOIRS AND PROCEEDINGS OF THE ROYAL ASTRONOMICAL SOCIETY.

LONDON:

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1852.

ROYAL ASTRONOMICAL SOCIETY.

VOL. XII. *November 14, 1851.* No. 1.

J. C. ADAMS, Esq. M.A., Fellow of St. John's College, Cambridge, President, in the Chair.

William Gray, Esq., York; and

J. W. Stephenson, Esq., 15 New Dorset Place, Clapham Road, were balloted for and duly elected Fellows of the Society.

The superintendent of the *Nautical Almanac* has printed an ephemeris of Encke's comet for January, February, and half of March 1852, and an ephemeris of *Victoria* during its opposition in January. Most of the observers who are likely to make use of these ephemerides are probably supplied with them by the kindness of the superintendent; but if any oversight has occurred, application may be made either directly to the *Nautical Almanac* office, or through Mr. Williams, our assistant-secretary.

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*New Planet discovered by Dr. A. de Gasparis.**

On Dec. 8, 1851, Professor de Gasparis discovered a faint planet in the vicinity of *Saturn*, of which the following are the approximate places:—

1851.	Naples M.T. h m s	R.A. s	Decl. ′ ″
Dec. 8	7 10 6·4	Saturn −31·7	Saturn −2 55
9	7 10 40·3	Saturn −30·5	Saturn −2 59

HAMBURG. (M. C. Rümker.)

1851.	Hamburg M.T. h m s	R.A. h m s	Decl. ° ′ ″
Dec. 24	7 8 4	1 45 32·37	+8 10 22·5

Brorsen's Fifth Comet (1851, *October* 22).

This comet has a bright nucleus, and a brilliant tail, more than 1° long.

1851.	Senftenberg M.T. h m s	R.A. h m s	Decl. ° ′ ″	
Oct. 22	8 3	13 39·4	+32 35·5	Approxim.
	17 17 13·5	13 42 1·3	+32 50 6	

"The latter place depends on a rather roughly reduced comparison with Bessel Z. 414; $13^h\,43^m\,18^s{\cdot}1$ $+33^\circ\,15'\,43''$.

"The daily motion is $+6^m\,16^s{\cdot}6$ and $+1^\circ\,16'{\cdot}3$."

M. Brorsen adds in a postscript, "The comet has two tails; the less, as in Bessel's drawing, is turned to the sun."

* If the places here given refer to the same object, it must be, in all probability, a satellite of *Saturn*.

Observations.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1851.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	Star of Comp.
Nov. 12	7 2 0·7	15 15 8·84	+8·726	46 21 58·9	−9·8358	B.A.C. 5157
17	6 12 6·5	15 33 54·23	8·751	44 54 71·4	9·7668	— 5287
	6 41 11·6	58·58	8·745	54 60·8	9·7986	— —
	7 14 11·3	63·77	+8·729	54 33·0	−9·8430	— —

The observations are corrected for refraction. P = the equatoreal horizontal parallax in arc, p = the correction for parallax in right ascension in time, and q = the correction in north polar distance in arc.

The following assumed *mean* places of the Stars of Comparison for 1851·0 were derived from the Oxford Observations.

	R.A. h m s	N.P.D. ° ′ ″
B.A.C. 5157	15 30 3·71	46 20 11·19
— 5287	15 49 40·16	46 25 27·75

"On the 12th further observation was prevented by clouds. The comet was very faint on the 17th. The nucleus on the 12th was steadily seen, generally as a very minute star, but occasionally, for intervals of a few seconds, it appeared quite bright, and had a rather large planetary disc. The tail was about 40′ long, and about 2′ broad in the widest part; it was directed from the sun, and was formed by the curvilinear rays of light proceeding from the nucleus and meeting at the end of the tail, which terminated in a point."

Elements.

By M. George Rümker.

Computed from the observations at Senftenberg, Oct. 22; at Vienna, Oct. 24; and at Berlin, Oct. 30.

Perihelion Passage, 1851, Sept. 30·66264, Berlin M.T.

	° ′ ″	
Longitude of Perihelion......	339 46 4	Appt Eqx. Oct. 24, 1851.
— Node	41 38 30	
Inclination	73 3 0	
Log q	9·214886	

Motion direct.

MM. Vogel and G. Rümker forwarded at the same time an approximate ephemeris from Nov. 8 to Dec. 2, inclusive.

PARTHENOPE.

HAMBURG. Equatoreal. (M. C. Rümker.)

1851.	Hamburg M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″
Oct. 17	9 44 35·7	29 51 42·1	+3 45 56·6
18	11 4 14·6	29 37 4·3	3 40 0·1
Nov. 2	8 3 22·7	26 14 45·8	+2 29 44·4

Liverpool. Equatoreal. (Mr. Hartnup.)

1851.	Green. M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	Stars of Comp.
Oct. 30	10 10 53·6	1 47 27·94	87 18 55·4	B.A.C. 518, 625
	10 40 48·3	26·88	58·1	— — —
Nov. 7	10 8 45·2	40 51·35	46 38·6	— 625
	10 28 41·9	50·79	40·3	— —
10	9 37 50·5	38 40·99	54 4·2	— —
	10 2 46·0	40·11	6·3	— —
12	10 16 28·9	37 18·38	87 58 6·2	— —
15	9 27 56·1	35 27·69	88 2 37·8	— —
	10 2 50·4	27·02	40·1	— —
17	9 38 53·7	34 20·15	4 38·5	— —
	10 8 48·8	19·42	40·4	— —
18	12 25 58·4	33 45·10	5 27·4	— —
	12 55 54·0	44·47	29·4	— —
21	9 5 17·5	32 24·78	6 19·1	— 448, 625
	9 55 9·6	24·12	18·0	— — —
22	8 38 59·9	1 31 60·18	88 6 10·4	— — —
	9 18 54·2	59·37	13·5	— — —

The observations are corrected for refraction and parallax. The log Δ for parallax was taken from the ephemeris of MM. Luther and Vogel.

The following assumed *mean* places of the Stars of Comparison, 1851·0, were derived from the Greenwich Observations.

	R.A. h m s	N.P.D. ° ′ ″
B.A.C. 448	1 22 22·92	84 37 33·78
— 518	1 33 40·82	85 16 6·48
— 625	1 54 20·49	87 57 28·08

Haverhill. (Mr. W. W. Boreham.)

1851.	Green. M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	No. of Obs.	Star.
Sept. 22	10 17 55	2 17 35·92	83 53 17·5	4	*a*
28	9 36 42	14 26·80	84 24 39·0	5	*a*
29	10 11 22	13 49·32	30 21·8	5	*b*
Oct. 4	10 42 15	10 21·54	84 59 4·0	6	*b*
5	9 35 31	2 9 38·45	85 4 34·8	5	*b*
24	9 22 59	1 52 56·64	86 51 5·1	6	*c*
Nov. 2	8 11 36	1 44 56·91	87 30 20·6	6	*d*

The observations are corrected for refraction and parallax. The parallax is taken from MM. Luther and Vogel's ephemeris.

Mean places of Stars of Comparison.

Name. h	R.A. h m s	N.P.D. ° ′ ″
a = Weisse, ii, 244	2 15 36·33	84 4 43·7
b = — – 192	2 12 33·86	84 48 11·3
c = Weisse, i, 962	1 53 55·47	87 2 10·9
d = Green. 12-yr. Cat. 169, 111 Piscium	1 45 50·70	87 33 2·9

Ephemeris (continuation). By MM. R. Luther and E. Vogel.

For 0^h Berlin M.T.

1852.	R.A. h m s	Decl. ° ′ ″	Log Δ.	Time of Aberr. in Decimals of a Day.
Jan. 1	1 37 26·00	+ 4 15 45·1	0·300070	0·01139
2	38 4·24	22 4·2	·303015	01147
3	38 43·71	28 28·9	·305949	01155
4	39 24·43	34 59·2	·308872	01162
5	40 6·33	41 34·8	·311784	01170
6	40 49·43	48 15·5	·314685	01178
7	41 33·69	+ 4 55 1·1	·317574	01186
8	42 19·09	+ 5 1 51·7	·320451	01194
9	43 5·64	8 47·0	·323315	01202
10	43 53·30	15 46·7	·326165	01210
11	44 42·07	22 50·9	·329001	01218
12	45 31·92	29 59·3	·331824	01225
13	46 22·84	37 11·8	·334632	01233
14	47 14·81	44 28·3	·337425	01241
15	48 7·83	51 48·7	·340204	01249
16	49 1·87	+ 5 59 12·7	·342968	01257
17	49 56·91	+ 6 6 40·3	·345717	01265
18	50 52·95	14 11·4	·348450	01273
19	51 49·96	21 45·9	·351168	01281
20	52 47·94	29 23·5	·353869	01289
21	53 46·87	37 4·3	·356554	01297
22	54 46·74	44 48·1	·359221	01305
23	55 47·54	+ 6 52 34·6	·361870	01313
24	56 49·24	+ 7 0 23·9	·364502	01321
25	57 51·83	8 15·7	·367117	01329
26	58 55·31	16 9·9	·369714	01337
27	1 59 59·63	24 6·4	·372294	01345
28	2 1 4·79	32 5·0	·374855	01353
29	2 10·79	40 5·6	·377399	01361
30	3 17·62	48 8·1	·379924	01369
31	4 25·23	+ 7 56 12·5	·382431	01377
Feb. 1	5 33·64	+ 8 4 18·5	·384919	01385
2	6 42·83	12 26·0	·387389	01393
3	7 52·77	20 35·0	·389840	01401
4	9 3·46	28 45·2	·392273	01409
5	10 14·89	36 56·7	·394687	01416
6	11 27·04	45 9·3	·397083	01424
7	12 39·91	+ 8 53 22·8	·399460	01432
8	13 53·48	+ 9 1 37·2	·401818	01440
9	15 7·55	9 52·4	·404157	01448
10	2 16 22·69	+ 9 18 8·3	0·406478	0·01455

1852.	R.A. h m s	Decl. ° ′ ″	Log Δ.	Time of Aberr. in Decimals of a Day.
Feb. 11	2 17 38·31	+9 26 24·8	0·408780	0·01463
12	18 54·61	34 41·7	·411064	01471
13	20 11·56	42 59·1	·413328	01478
14	21 29·16	51 16·8	·415574	01486
15	22 47·41	+ 9 59 34·8	·417801	01494
16	24 6·29	+10 7 53·0	·420009	01501
17	25 25·79	16 11·2	·422198	01509
18	26 45·91	24 29·4	·424368	01517
19	28 6·64	32 47·4	·426519	01524
20	29 27·94	41 5·3	·428651	01532
21	30 49·87	49 22·8	·430764	01539
22	32 12·35	+10 57 39·9	·432857	01546
23	33 35·41	+11 5 56·6	·434931	01554
24	34 59·04	14 12·6	·436987	01561
25	36 23·21	22 28·0	·439024	01569
26	37 47·92	30 42·6	·441041	01576
27	39 13·17	38 56·3	·443039	01583
28	40 38·94	47 9·0	·445017	01590
29	42 5·23	+11 55 20·7	·446977	01598
March 1	43 32·02	+12 3 31·2	·448918	01605
2	44 59·31	11 40·4	·450840	01612
3	46 27·09	19 48·5	·452742	01619
4	47 55·36	27 55·1	·454626	01626
5	49 24·10	36 0·4	·456492	01633
6	50 53·31	44 4·0	·458339	01640
7	52 22·99	+12 52 6·1	·460168	01647
8	53 53·13	+13 0 6·6	·461978	01654
9	55 23·71	8 5·2	·463770	01661
10	56 54·75	16 2·1	·465543	01667
11	58 26·23	23 57·1	·467298	01674
12	2 59 58·16	31 50·1	·469035	01681
13	3 1 30·52	39 41·3	·470753	01687
14	3 3·31	47 30·3	·472453	01694
15	4 36·53	+13 55 17·3	·474135	01701
16	6 10·17	+14 3 2·0	·475799	01707
17	7 44·22	10 44·5	·477445	01714
18	9 18·67	18 24·7	·479073	01720
19	10 53·53	26 2·4	·480682	01726
20	12 28·79	33 37·7	·482273	01733
21	14 4·43	41 10·5	·483846	01739
22	15 40·47	48 40·7	·485401	01745
23	17 16·88	+14 56 8·5	·486938	01752
24	3 18 53·67	+15 3 33·4	0·488457	0·01758

1852.	R.A. h m s	Decl. ° ′ ″	Log Δ.	Time of Aberr. in Decimals of a Day.
March 25	3 20 30·83	+15 10 55·5	0·489958	0·01764
26	22 8·35	18 14·8	·491441	01770
27	23 46·21	25 31·0	·492906	01776
28	25 24·43	32 44·2	·494353	01782
29	27 2·99	39 54·4	·495782	01788
30	28 41·88	47 1·6	·497194	01793
31	30 21·11	+15 54 5·5	·498588	01799
April 1	32 0·65	+16 1 6·2	·499965	01805
2	3 33 40·51	+16 8 3·6	0·501325	0·01811

EUNOMIA.

HAMBURG. (M. C. Rümker.)

1851.	Hamburg M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″
Oct. 4	7 52 53·1	278 5 24·3	−21 43 43·8
8	7 4 14·0	279 10 12·0	21 29 50·3
18	6 58 4·2	282 10 41·7	20 52 24·7
25	6 46 19·8	284 29 49·3	−20 24 45·7

EGERIA.

*Ephemeris** (*continuation*). By M. G. Rümker.

12h Berlin Mean Time.

Date. 1852.	R.A. h m s	Decl. ° ′	Log Δ.	Date. 1852.	R.A. h m s	Decl. ° ′	Log Δ.
Jan. 1	12 14 2	+19 58·8	0·28730	Jan. 17	12 23 14	+20 33·9	0·24799
2	14 49	+19 59·7		18	23 34	37·4	
3	15 34	+20 0·7		19	23 52	41·0	
4	16 17	1·9		20	24 9	44·9	
5	16 59	3·3	0·27741	21	24 24	48·8	0·23842
6	17 39	5·0		22	24 37	52·9	
7	18 18	6·9		23	24 48	+20 57·1	
8	18 55	8·9		24	24 57	+21 1·6	
9	19 30	11·1	0·26754	25	25 5	5·9	0·22909
10	20 4	13·4		26	25 10	10·5	
11	20 36	15·9		27	25 14	15·2	
12	21 6	18·6		28	25 15	20·0	
13	21 35	21·3	0·25772	29	25 15	24·9	0·22011
14	22 2	24·2		30	25 13	29·9	
15	22 28	27·3		31	12 25 8	+21 35·0	
16	12 22 52	+20 30·6		Feb. 1	12 25 1	+21 40·2	

* *From Professor* Encke's elements, Berliner Jahrbuch, 1854.

Date. 1852.	R.A. h m s	Decl. ° ′	Log Δ.	Date. 1852.	R.A. h m s	Decl. ° ′	Log Δ.
Feb. 2	12 24 52	+21 45·5	0·21159	Feb. 17	12 18 47	+23 9·4	
3	24 41	50·8		18	18 7	14·9	0·18395
4	24 29	+21 56·2		19	17 26	20·3	
5	24 14	+22 1·7		20	16 43	25·7	
6	23 58	7·2	0·20365	21	15 58	31·0	
7	23 39	12·8		22	15 12	36·2	0·19791
8	23 18	18·4		23	14 24	41·2	
9	22 56	24·0		24	13 35	46·2	
10	22 33	29·7	0·19635	25	12 44	51·0	
11	22 7	35·4		26	11 51	+23 55·7	0·17528
12	21 38	41·1		27	10 57	+24 0·2	
13	21 8	46·8		28	10 1	4·6	
14	20 36	52·5	0·18975	29	9 4	8·8	
15	20 1	+22 58·2		Mar. 1	12 8 6	+24 12·9	0·17253
16	12 19 25	+23 3·8					

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*Note on the Planet Victoria.** By M. Yvon Villarceau.

"The ephemeris of the third planet discovered by Mr. Hind, which I have calculated for every day during six months and a half, depends on the observations during forty-three days. In publishing it, I presented at the same time a comparison of the meridian observations of Paris with my ephemeris. The observations of other astronomers during the whole period agree as well as I could expect with the ephemeris, the maximum errors being $0^s{\cdot}66$ in R.A. and $7''{\cdot}4$ in declination.

"To obtain still greater accuracy, I have represented, graphically, the comparisons published by MM. Hartnup, Carrington, Vogler, and Graham, along with those of the observatories of Paris and Cambridge. I have also deduced comparisons from three months' observations made at Washington and collected by Mr. Ferguson. In this way I have constructed nearly 200 ordinates in right ascension and as many in declination, representing the excess of observation above the computations of the ephemeris. Through each of these series of points I have drawn a continuous curve, contenting myself, however, for the first forty days with satisfying, as far as was possible, the Paris meridian observations; and for the rest of the time, with satisfying the observations of Mr. Hartnup. My reasons for this preference are, the great accordance of the Paris observations, with one or two exceptions; and that Mr. Hartnup, whose observations also agree well together, has referred the planet to well-determined stars.

* **M. Villarceau has used the name *Clio;* but Mr. Hind, the discoverer, in the exercise of his undoubted right, has selected the name of *Victoria*, a well-established heathen *goddess*.**

"Taking the ordinates of the two curves for the excess of the observations above the ephemeris, and adding this excess to positions deduced from the ephemeris, I have obtained the fourteen normal positions set down in the following table:—

For Paris Mean Noon.

	Observed—Calculated. R.A.	Decl.	Normal Positions. R.A.	Decl.
1850.	s	″	h m s	° ′ ″
Sept. 18	−0·11	0·0	23 41 1·26	+13 26 42·6
30	·08	+0·2	31 48·31	11 21 41·7
Oct. 12	−0·05	0·8	25 19·75	9 9 39·2
24	+0·04	1·5	23 0·18	7 13 26·0
Nov. 9	·25	2·7	25 6·70	5 46 39·3
17	·42	4·2	31 19·85	5 54 18·2
29	·54	5·3	40 58·47	4 35 4·6
Dec. 11	·61	6·4	23 53 22·03	4 44 51·8
23	·66	7·1	0 7 53·90	5 18 38·8
1851. Jan. 10	·61	7·3	32 39·55	6 43 11·9
25	·45	7·0	0 55 16·49	8 15 6·0
Feb. 9	·28	6·9	1 19 12·46	9 58 24·3
24	+0·08	7·0	1 44 8·27	11 46 40·6
Mar. 11	−0·06	+7·4	2 9 51·98	+13 24 32·0

M. Villarceau then explains his mode of correcting the elements by means of the normal places, and deduces the following *corrected* elements, which represent the observations very closely:—

	° ′ ″	
Mean Anomaly	65 46 47·36	1851, Jan. 0·0, Paris M.T.
Long. Perihel.	301 55 17·57	Mean Equinox, 1851, Jan. 0.
— Asc. Node	235 29 31·41	
Inclination	8 23 6·78	
Angle (sin = excentricity)...	12 36 11·58	
Mean Daily Helioc. Motion	994″·43246	
Semi-axis Major	2·3350032,	log = 0·3682875
Excentricity	0·2181980	
Sidereal Period. Time......	3y·5680582	

"The differences between these elements and the normal places are very small. Part of the differences may arise from the uncertainty of the graphical interpolation, which is caused in a great measure by the errors of the observations.* The errors of the tables of the sun and the effects of perturbation must also be taken into

* "These errors are largest in right ascension, both in the meridian and equatoreal observations, which is probably owing to the difficulty of illuminating the telescope where such faint objects are observed. It seldom happens that a small planet can be observed in position and distance like a double star. We may expect that the powerful meridian instrument, which Mr. Airy has recently erected at Greenwich, will not present the great discordances in right ascension which are now found in the observations of the faint planets."

account. From the systematic march of the errors, I should be inclined to suppose them due to perturbation.

"I will avail myself of the present opportunity to make a remark on the construction of my ephemeris of *Victoria*. The linear co-ordinates of the sun, taken from the *Nautical Almanac*, have been, as I have mentioned elsewhere, corrected for the terms depending on the sun's latitude. But M. Schumacher communicated to me a remark made by M. Götze, that these co-ordinates have been calculated with a radius vector of the earth, *affected with aberration.* I have only attended to this remark in that part of the ephemeris which belongs to the first three months of 1851. The rectilineal co-ordinates of the sun are so very convenient in use that it is desirable the superintendent should take the preceding remark into consideration; since the *Nautical Almanac* is a work which every astronomer must daily use, and whose merits every astronomer must highly appreciate."

Observations of the Planet Saturn with the 20-foot Equatoreal. By Mr. Lassell.

"*September* 9, 11½ p.m. The phenomena of *Saturn* were extremely well shown, the air being in an unusually fine state, though some unsteadiness still remained. Power 430. The division of the ring easily visible along the whole of that part of the ring between us and the ball. No other division could be made out certainly. The more dusky surface of the exterior ring gave a striped impression, but no certain line. The 'veil' extended exactly half way from the inner boundary of the inner ring to the nearest edge of the ball. The termination of it was well defined towards the ball, and the sky within it perfectly black, as much so as any part of the sky. But the exterior boundary, though pretty well defined, was less so than the interior; and beyond its evident termination there was a faint but very evident shade upon the ring. No difference in depth of shade of the 'veil' could be suspected, and certainly no dark division separating it into two, neither could any darker division be made out between the 'veil' and the bright ring. Once, for an instant, I suspected a darker boundary, but the impression did not return. Certainly the planet is seen to-night to such advantage, that, if such divisions exist, I think I ought to see them. The shadow of the ball on the ring seemed to be bounded by a straight, not a curved line—or if curved at all, it is concave towards the ball. I could not well trace the dark shade crossing the ball in a continuous line to the dark shade within the ring—it seemed as if the sky dipped down into it, then encroaching upon it and reducing its breadth at those points where the planet's limb touches (apparently) the ring. The faint shading on the bright ring may be traced (growing gradually fainter) to within less than the breadth of the exterior ring of its outer circumference. The

satellite *Mimas* was steadily seen, even when considerably past his greatest western elongation.

"*September* 10. I surveyed *Saturn* from $11\frac{1}{2}^h$ to 13^h with various powers, *e.g.* 366, 430, 614, and 864, the air being occasionally remarkably fine, so as to exceed the atmosphere of last night, and give me the most exquisite glimpses of the phenomena of the planet. The drawing which accompanies this paper is the most faithful picture I have been able to execute of the appearances which presented themselves. I am confirmed in my impression that there is no difference in the deepness of the shade of the dusky ring or 'veil'—that it is not obviously separated into two, and that there is no black line or division of sensible breadth separating it from the bright ring. The breadth of the veil, where it crosses the planet, is about the breadth of the inner bright ring at the same point—it ought to be not quite so broad, but the lighter shading on the interior portion of the inner bright ring may modify the judgment. The shadow of the ball on the ring is *slightly* concave towards the ball; nothing extraordinary in the *shape* of the shadow.

"I had many sharp glimpses of the outer ring, even with the high powers, and its outline was perfectly sharp and distinct; but no positive division could anywhere be traced, notwithstanding that this was, taken altogether, the most powerful view of *Saturn* I ever had. The plane of the exterior ring was strongly shaded parallel to its circumference, so as to give an impression of divisions; but I believe they were not real—only markings on the surface. The satellites *Mimas* and *Enceladus*, seen in the positions depicted in the drawing, strongly show the power of the telescope and the goodness of the circumstances. At $12^h\ 30^m$ *Mimas* was nearly over the preceding end of the ring; and *Enceladus* was very little short of his apparent conjunction south of the ball. In this position they were seen steadily and well with power 864, and without any contrivance to hide the splendour of the planet.

"*September 12th.* Most extraordinarily, to-night is also fine, making the fourth of almost unprecedented beauty. Two friends observing with me prevented my noting down the phenomena, as on the 9th and 10th, at the time of observation; and the record of what I saw was made on the following morning. About 11^h the telescope was turned upon *Saturn*, and we surveyed him with various powers, viz. 430, 560, 614, and 864, as the increasing altitude of the planet allowed us to see him through a thinner medium. The night was excessively dewy, the fields being covered with fog up to the tops of the hedges; and indeed the whole sky up to within a little of the zenith was hazy or foggy. This, however, cleared off later in the night, and from 13^h to 14^h *Saturn* appeared with unequalled beauty. *Enceladus* was watched up to the moment of his apparent inferior conjunction, which I estimated to take place at $13^h\ 59^m$ G.M.T.

"My impressions received this evening confirm in the fullest manner those described in the observations of the 9th and 10th

instants. I could not perceive that there was any shading of deeper intensity than the rest in any part of the obscure portion of the ring, which I have usually called the 'crape veil.' Under the singularly favourable circumstances of these three evenings, (the state of the air being almost unprecedented, and the telescope with 20 and 22 inches aperture leaving nothing to desire in sharpness of definition), my attention has been directed in the most concentrated manner to the structure of the recently observed appendage of *Saturn*, which has been called the dark ring; and I arrive deliberately at the following conclusions:—That there is no evidence to me of any *division* between the 'crape veil' and the anterior portion of what has been hitherto considered the inner ring; though there is a faint shading, which begins about the middle of the bright inner ring, deepening towards the 'veil;' but even when it touches it, it is much less dark than the 'veil,' and it touches it without the intervention of any black division or sky between. And a careful survey of the whole surface of the veil on both sides of the ball shows me no irregularity of depth of shade, much less any *division* separating it into two.

"To perpetuate the impression of these telescopic visions of the planet I made a drawing of it as it appeared on the 10th of September, accompanied by the nearest two satellites. Of this drawing I have had a lithographic copy made, with as much faithfulness as I have been able to secure, some impressions of which accompany this paper.

"I must, however, acknowledge that it falls short of the beauty of the telescopic image; the drawing of the several ellipses of the boundaries of the rings not being quite symmetrical, especially the exterior outline on the north preceding side. The belt on the ball is also a little too dark, and its edges too hard. In other details it is pretty faithful; the kind of edge which appeared to me to form the exterior boundary of the veil, especially so."

On the Planet Saturn and his Rings. By Mr. Dawes.

"The night of October 26th (up to about $11^h 45^m$, when it suddenly clouded) was remarkable for distinctness of definition; and I employed part of it in examining the planet *Saturn* with high powers on my $8\frac{1}{2}$-foot refractor. The results of the scrutiny were in some respects different from what I had ever seen before, and I hope they will not be uninteresting to the Society.

"The sky was hazy, the stars shining with a dim lustre ('*stellis acies obtusa*'). But on turning the telescope upon *Saturn*, I was struck with the beauty of the definition. A power of 585 (determined by measuring the emergent pencil) was borne with admirable distinctness, and the phenomena observed were as follows:

"On the *outer bright ring* was steadily visible a very narrow

black line, a little exterior to the middle of the ring. It appeared to be far too dark, narrow, and sharply defined to be merely a shading or belt, and gave the decided impression of being a division of the ring. This I had seen, but less perfectly, on September 11th; and I have had glimpses of it on other nights.

"The *principal division* between the bright rings was steadily seen throughout its whole extent till lost behind the ball; and was beautifully black and sharply defined.

"But the most remarkable appearances were observed on the *inner bright ring*. Its exterior portion to about one-fourth of its whole breadth was very bright, being of about the same colour as the brilliant zone on the ball immediately to the north of *Saturn's* equator. Interior to this, the shading off did not appear, as under ordinary circumstances, to become deeper towards the inner edge *without any distinct or sudden gradations of shade*. On the contrary, it was clearly seen to be arranged in a series of *narrow concentric bands*, each of which was somewhat darker than the next exterior one. Four such were distinctly made out. They looked like *steps* leading down to the black chasm between the ring and the ball. The impression I received was that they were *separate rings*; but too close together for the divisions to be seen as black lines. The slightest undulation of the image was sufficient to confuse the different shadings, and to destroy the step-like appearance.

"Immediately interior to the inner edge of the bright ring was a *black elliptic line*, forming a distinct separation between the bright and the faint rings. This I have satisfactorily made out on several good nights during both the last and the present apparition of the planet, and especially on the 11th of last September, which was here remarkably fine; but never before with such perfect steadiness as on the present occasion. I could trace it, occasionally, along the inner edge of the bright ring, fully half-way to the ball.

"The *exterior faint ring* was pretty steadily visible, though very faint to-night from the dull condition of the planet. Yet occasionally, for several seconds together, both its outer and inner edge were distinctly seen;—the inner edge being distant from the inner edge of the bright ring about one-third of the interval between that edge and the ball.

"From the thick state of the air, the *interior faint ring*, of whose separate existence I satisfied myself last winter, was only occasionally seen. On several previous nights, however, during the present autumn, I have seen it far better, as, from its excessive faintness, it requires clear air as well as good definition. On September 11th I had an excellent view of it, and it was then seen to extend very nearly, if not quite, to the middle of the interval between the bright ring and the ball. I have never, I believe, obtained a glimpse of it beyond this.

"Where the ring crosses the ball, the *shadow of the ring* appeared as a very narrow black line contiguous to the *northern* edge *of the ring*. At the southern edge of the same portion of the ring,

the projection of the faint rings on the bright zone of *Saturn* appeared, I thought, as black as the shadow itself; being considerably broader, and seen in contrast with the most brilliant portion of the planet; while the *shadow* was thrown upon the belt-like cap which covers the northern part of the ball.

"The superiority of exquisite definition with only a moderate quantity of light, in bringing out the minutiæ of planetary surface, over a far greater brilliancy of the object with less perfect distinctness, was strikingly exemplified by the observations of October 26. On that night *Saturn* had not half its usual brilliancy; yet, with the exception of the faint rings, no part of the planet appeared to be deficient in light; on the contrary, with an emergent pencil less than $\frac{1}{90}$th of an inch in diameter, its image in the telescope when best seen possessed the distinctness of an engraving.

"So peculiarly attractive as the planet *Saturn* has always been to telescopic observers, with large instruments especially, it seems almost unaccountable that the appearance of *a dark line on the ball at the interior edge of the ring, while the shadow of the ring was evidently thrown to the other side of it*, often as such a state of things must have been visible, should not long ago have suggested the existence of a dark interior ring; for this seems to be the only hypothesis capable of accounting for such an appearance: and it would have been perfectly tenable if no evidence of the existence of such a ring had been found in the light, now obvious enough, in the interval between the bright ring and the ball."

Notice of Saturn and his Rings. By Mr. Isaac Fletcher.

"On several very fine nights towards the close of October last, I carefully examined the planet *Saturn* with my 6-foot equatoreal of $4\frac{1}{7}$ inches aperture, and on every night I distinctly and steadily saw the new obscure interior ring, which was discovered last year by Messrs. Bond and Dawes. On each occasion I estimated its breadth at almost exactly one-third of the space between the inner edge of the bright ring and the planet. Its colour to my eye is a *dusky grey*. In all the observations a power of 300 was found most efficient. Of the division of the outer ring my telescope afforded no evidence whatever. This, of course, I anticipated from its limited aperture.

"On the 12th of this month (November) I paid a visit to my friend Mr. Pattinson, of Scots House, near Newcastle-upon-Tyne; and about 8 o'clock in the evening we directed Mr. Pattinson's equatoreally mounted achromatic telescope of $10\frac{3}{4}$ feet focus, and $7\frac{1}{4}$ inches clear aperture upon *Saturn*, and subjected the planet to a rigorous scrutiny. At this hour the state of the atmosphere was exceedingly favourable for delicate observation; and with powers 400 and 440 the definition of the planet and rings was almost perfect, the outlines being exceedingly hard and sharp. The presence of the moon was of course unfavourable for seeing very faint

objects; notwithstanding this, however, the interior obscure ring was obvious and distinct, but we had no evidence of its being multiple. In moments of best vision Mr. Pattinson and I were both quite satisfied of the existence of a very *narrow*, *faint line* on the outer ring; and we were both of the opinion that this line was nearer to the *outer* than to the inner edge of the ring. This line was only visible at intervals, and after the most steady gazing; nevertheless, the evidence obtained was sufficient to satisfy us of its existence. In a short time, the state of the atmosphere deteriorated very considerably, and we were unable to obtain any further views of this faint line, which may fairly be assumed to be a *division* in the outer ring.

" I am induced to make this communication to the Royal Astronomical Society, not because it contains any *new facts*, but because it confirms in some important particulars the observations of other astronomers. Mr. Pattinson's equatoreal is a recent specimen of the skill of Mr. Cooke of York."

Note on the Appearance of Saturn and his Rings. By Mr. W. De la Rue.

" I have had an opportunity of observing *Saturn* since my return from Paris, and of making a sketch of its present aspect. In a few days I hope to complete a drawing, and will send it for inspection to the Royal Astronomical Society.* The time of observation was between the 12th and 15th hour of the 13th August, one of the finest nights I have ever had, notwithstanding a very slight haze illumined by the bright moonlight.

" The division between the two principal rings was as black as if drawn with ink, and extended quite up to the shadow of the planet on the ring: the details, that is, the light and dark portions of the two rings, were seen very beautifully with all the powers employed from 150 to 450.

" Four satellites were visible, one so close to the southern pole of the planet that I believe it to be the first or nearest.

" The *dark* ring was very fine, its inner edge being perfectly sharp and well defined, and extending much nearer to the planet than it appeared to me to do when I made my last drawing; the circumstances, however, were much more favourable on this occasion, the atmosphere remaining steady for several seconds at a time, which enabled me to observe much more calmly, and, consequently, to make a less hurried sketch. The real shadow of the rings on the planet was only a very narrow black line; the dark ring crossing the planet was not nearly so black as the division between the two principal rings.

" Lastly, the shadow of the planet on the dark ring was curved.

" P.S. No division was visible in the dark ring, which was quite uniform in colour."

* **An exquisite drawing by Mr. De la Rue was sent with the above account.**

On the Interior Satellites of Uranus. By Mr. Lassell.

Extract of a letter dated Nov. 13, 1851 :—

"After a ten-day painful exercise of patience, I obtained last night, still under great disadvantages, another view of the two new satellites of *Uranus*. The sky was so generally cloudy and always hazy through the whole of last night, that I could get no absolute measures (save one) of either position or distance of either even of the bright satellites; though I managed to get a view of both the close ones, and also as good estimations of their situations with respect to the bright ones, as convinced me that no great error of position could exist. In default of measures, I estimated the position of IV to be 5°, and of III to be 110°. I afterwards obtained a single rough measure of III which gave, position 112° 34′; 2 was estimated, in distance *fully* six-tenths of the distance of III; 1 was decidedly closer, and barely one-third of the distance of IV : 2 obviously brighter than 1, as it also was on the 2d November. I made a diagram of the positions of the four satellites in my observation book with as much care as possible; and I inclose you a copy of it reduced to a scale of 1″ = 0·05 inch, the angles of position being deduced by the application of a protractor. I ought to add that, in order to avoid the possibility of prejudice, I entered into no calculation whatever of the expected positions of the satellites, until all was written down in my book, and I had come in from the observatory. I had, indeed, at the time of observation, no knowledge which was the most likely quadrant of location of any of them. The powers used were 614 and 760, and the epoch $10^h\ 30^m$."

Mr. Lassell finds that a periodic time of 2·506 days will satisfy the place of 1, and a period of 4·150 days the place of 2, and that the estimated elongations agree pretty fairly with the elongations calculated from the periodic times.

"It may, however, be necessary to say a word in reference to M. Otto Struve's, and indeed my own former observations of an interior satellite or satellites (see *Monthly Notices*, 14th January, 1848, and 10th March, 1848). I confess I never thought my own observations sufficiently connected and definite to be worthy of the very ingenious and elaborate discussion given by my friend Mr. Dawes as the basis (in conjunction with M. Struve's observations) of an assumption of periods for three interior satellites. And, indeed, in the memoirs of both these distinguished astronomers, various suppositions are necessarily introduced to account for what would otherwise be irreconcileable observations.

"I cannot, indeed, assert that *Uranus* has no interior satellites besides these two; but I feel very confident, that if they exist, they must be very much fainter than either 2 or 1 (which I now observe easily in good circumstances) or they could not have escaped my notice. It appears to me that the most probable hypothesis to explain M. Otto Struve's and my own former observations, is to conclude that we sometimes observed one satellite and sometimes the

other; especially as I is generally brighter than 2, and if near its greater elongation might be seen when 2 otherwise situated would be invisible. This would explain the difficulty of reconciling the observations."

Extract of a letter dated Nov. 29, 1851:—

"It is rather remarkable that, since I first saw these satellites, I have never looked for them without seeing them, though on some occasions, *e.g.* Nov. 21, the 2d, always the faintest, was recognised with most extreme difficulty. I inclose a tracing of the diagrams made on four more evenings, viz., up to Nov. 22, which, compared with the observations of the 2d, give periods of 2·509 days $= 2^d\ 12^h\ 13^m$, and 4·126 days $= 4^d\ 3^h\ 1^m$ respectively. I have not yet been able to measure their distances directly and absolutely from the centre of the planet, as its brightness, when fully in the field, always either entirely extinguishes them or renders it impossible to apply the micrometer. I shall, however, if I am not soon favoured with weather sufficiently fine for this purpose, measure the faint ones from the bright ones, and in this way get at their distances. Hitherto all the fine sky I have had has been used in measuring the positions and distances of the old satellites, of which I am getting as many measures as I can during this apparition, with as much accuracy as possible; and when I have finished the series I will send them to the Society. I have also not quite neglected *Neptune*; but I wait also to complete his series. While observing *Uranus* I shall also carefully scrutinise all his neighbourhood, at least within 4′. I may mention that on the 2d inst., the *motion* of 2 in overtaking IV was evident during observation. When first seen it was sensibly short of the line joining the planet's centre and IV, and when last seen it was just perceptibly beyond it. In the various quadrants in which these satellites have been seen, I observe no difference of brightness which cannot be accounted for by their greater or less distance from the planet. I have certainly seen the nearest when within 10″ or 11″, and, therefore, have not found Sir W. Herschel's remark hold (in my experience), that the satellites generally disappeared when they came within about 22″ of the planet. I suppose the greatest elongations of I and 2 are now somewhere about 13″ and 18″, and therefore they never can come near Sir William's limits of visibility. I am led to presume that the flare round the planet in his telescope must have been the cause of the satellite not being seen within 22″. In my own telescope I have found differences in this kind of scrutiny which I can only attribute to the state of the air. Sometimes the satellites are more easily measured, and are better seen with the full aperture than with any diminution; and at others, 20 inches shows the close satellites more obviously. I attribute the sudden detection, and frequently repeated observation of these minute and close objects, to the superior action of my mirror under its recently applied system of lever support; it now defines better and brings out with more vividness and concentration minute *points of light.* The steadiness with which *Mimas* is seen, when

near its greatest elongation, with a power of 400 or 500, notwithstanding the splendour of *Saturn* and its widely-opened ring full in the field, is a proof of this."

*Table of Mr. Lassell's Observations of the Interior Satellites of Uranus.**

1851.	h m		Position. ° ′	Distance. ″
Nov. 12, at	10 30	IV	5 est.	
		III	112 30	
		2	131	
		1	332	
Nov. 17	10 30	IV	220 12	34·63
		III	257 34	24·09
		2	47	13
		1	337	12
Nov. 18	12 0	IV	191 6	36·83
		III	202 est.	
		2	316	13
		1	186	12
Nov. 21	11 44	IV	131 57	34·29
		III	91 7	21·38
		2	63	10
		1	123	12
Nov. 22	11 36	IV	101 32	
		III	38 50	
		2	329	17
		1	332	12

" Pray mention in the next *Monthly Notice* that in the diagram of the satellites of *Uranus*, vol. xi. p. 247, the words *north* and *south* should *change* places. The additional motion applied to my polishing machine answers well, but requires more attention than I think any body else would give. I wait to make some further trials before I announce it. I have looked twice for D'Arrest's comet with the aid of Mr. Pogson's ephemeris: the circumstances were not very favourable, and I failed to detect it."

D'ARREST'S COMET.

Elliptic Elements. By M. Yvon Villarceau.

" I have employed five observations made at Leipsic and Berlin between June 29 and July 6, and two observations made at Paris July 27 and August 3. The latter is rather doubtful, and I have only employed it from the impossibility of getting others without too great delay.

* The position of IV on Nov. 12 is *estimated*, as is the position of III on Nov. 18; the other positions of IV and III and the distances have been measured. The positions of 2 and 1 are given by Mr. Lassell from their configurations with the planet and brighter satellites; the distances are taken from Mr. Lassell's diagram according to his scale.

"A first trial showed me that a satisfactory result could not be deduced by using a method applicable to three observations, which is owing to the very small geocentric latitudes of the comet. The method which I have given for planets in the Additions to the *Connaissance*, 1852, is perfectly suited to this occasion.

Perihelion Passage, 1851, July 8·97942, Paris M.T.

Long. Perihel.	324° 10′ 26″·7	Mean Eq. July 9.
Ascending Node	149 21 52·2	
Inclination	14 14 40·7	
Angle (sine = excentricity)	44 43 3·1	
Mean Daily Heliocentric Motion	443″·7415	

"Hence we have,

Perihelion Distance	1·185163, log = 0·0737781
Excentricity	0·7036121
Semi-axis Major	3·99869, log = 0·6019177
Sidereal Revolution	7·99608 years.

"The elements represent the observations pretty fairly, though they are liable to considerable modification from future observations. It is scarcely probable that the *periodic* nature of the comet should be changed.

"I, too, had made the remark, which was suggested to the Academy of Sciences by M. Benjamin Waltz, that this comet might probably be the same as the comet of 1678 calculated by Douwes. But I think the perturbations during the interval must be computed before we can pronounce this identity to be proved."

Mr. Norman Pogson, who was lately engaged at Mr. Bishop's Observatory, and is now attached to the Radcliffe Observatory, had the kindness to compute a daily ephemeris of D'Arrest's comet, from the last corrected elements by Dr. D'Arrest, for the interval between Nov. 21 and Dec. 6, 1851. This ephemeris was forwarded to the possessors of powerful telescopes, Mr. Lassell, Professor Challis, &c., in the hope of obtaining some additional observations. Unluckily, from the state of the weather or the faintness of the comet, Mr. Pogson's zeal has not been rewarded by the rediscovery of the comet.

BRORSEN'S FOURTH COMET (1851, *August* 1).

HAVERHILL. (Mr. W. W. Boreham.)

1851.	Green. M.T. h m s	R.A. h m s		N.P.D. ° ′ ″		No. of Obs.	Star.
Aug. 13	9 47 46	14 17 15·03	+0·049 *p*	53 1 42·5	−0·53 *p*	3	*a*
14	11 1 3	19 27·92	0·050 *p*	52 32 15·8	0·65 *p*	3	*b*
18	10 10 47	28 26·60	0·053 *p*	50 37 57·5	0·56 *p*	6	*c*
21	9 38 5	35 43·69	0·052 *p*	49 10 45·5	0·47 *p*	3	*d*
28	9 9 29	14 55 10·91	+0·054 *p*	45 30 39·2	−0·42 *p*	3	*e*

p = *Horizontal* equatoreal parallax. The places are corrected for refraction.

Mean Places of Stars of Comparison.

Name.	R.A.	N.P.D.
	h m s	° ′ ″
a = B.A.C. 4797	14 22 5·68	53 7 59·9
b = — 4778	17 18·78	52 7 2·1
c = — 4812	26 4·84	51 2 17
d = Radcliffe Obs. vol. ix. No. 786	34 48·27	49 28 3·7
e = Lalande, No. 27447	14 56 32·22	45 42 20·5

Occultations of Stars by the Moon, observed at Ashurst, near Dorking. By Mr. Snow.

(Lat. 51° 15′ 58″ North; Long. $0^h\ 1^m\ 10^s$ West.)

	Star.	Ashurst Sid. T. of Immersion.	Limb.	Ashurst Sid. T. of Emersion.	Limb.	
1850.		h m s		h m s		
Nov. 8	33 Capricor.	20 17 3·15	dark			
1851.						
Feb. 21	*η* Libræ	......	...	16 32 8·7	dark	good.
Mar. 13	*d*[1] Cancri	8 44 15	dark	9 32 53	bright	good.
	θ Cancri	12 32 29·3	dark			
Sept. 14	845 B.A.C.	20 51 18	bright	22 49 2	dark	good.

Occultations of Stars by the Moon observed by Capt. Shadwell, R.N. F.R.A.S., at the Dockyard (Flag-Staff), Trincomalee.

Latitude of the Flag Staff, 8° 31′ 26″ North.

1851.		Mag.		Local M.T. h m s
July 12	*o* Sagittarii	4.5	Immersion	9 1 34·2
15	*δ* Capricorni	3.4	Emersion	15 39 41·1

A further memoir has been received from Mr. Maclear containing results of his comparison of the southern stars of the B.A.C. Catalogue with the heavens. The *observed* places depend upon from two to four observations with the 10-foot transit, and as many with the mural circle.

In assigning the probable source of error in Lacaille's catalogue, Mr. Maclear states that he has assumed, pretty freely, the likelihood of certain errors of reading off both the clock and instrument, which are of usual occurrence. This appears to him a more allowable process than to assign large proper motions. Probably, when his task is completed, the merely typographical errors of the *Cœlum Australe* may be got rid of by reference to the manuscripts.

If the zeal of the Cape astronomer and his assistants is supported by health and an adequate supply of labour, we may expect to have a Southern Catalogue, before long, on which we may rely.

Lord Wrottesley's Corrections of the British Association Catalogue. Third List of Stars observed by Mr. R. Philpot, in which the Right Ascension differs by more than one Second in Time from that Catalogue.

B.A.C.	Excess of Observed Mean Place above B.A.C.	No. of Obs.	B.A.C.	Excess of Observed Mean Place above B.A.C.	No. of Obs.
	s			s	
1962	−7·50	5	6187	− 1·27	4
4550	−6·03	3	6531	− 1·26	4
5038	−1·26	2	6854	+ 1·35	3
5051	−1·19	3	7268	+10·43	3
5142	−1·61	4	7417	+ 1·53	4
5211	−1·32	5	7523	−60·81	4
5228	−2·71	5	7549	− 1·10	5
5767	+1·70	3	8083	+ 1·50	5
5910	+1·64	5	8372	+ 1·26	2

Note from Mr. Dawes.

"In the Supplemental Number (No. 9) of vol. xi. of the *Monthly Notices*, it is stated, in an 'Extract of a Letter from the Rev. John Slatter, dated June 26, 1851,' that 'there was an occultation of *Jupiter's* fourth satellite on June 20th, at about $16^h\ 30^m\ 30^s$ sidereal time at Rose Hill, not mentioned in the *Nautical Almanac.*'

"Mr. Slatter will, I am sure, excuse my stating that this is a mistake. The satellite passed the planet *without being occulted.* I watched it with my $8\frac{1}{2}$-foot achromatic up to $10^h\ 48^m$ Greenwich mean time, $= 16^h\ 42^m$ Greenwich sidereal time, when it had obviously passed its superior conjunction. I entered in my journal that 'at the time of its nearest approach, the satellite was about its own diameter from the edge of the planet; it is very small in appearance, about as bright as the star which *Jupiter* occulted on May 8th' (which was of the 8th magnitude).

"Mr. Slatter remarks, 'The lowness of the planet prevented my making a satisfactory observation.' The state of the air seems to have been much finer at Wateringbury than at Rose Hill; as I was able, some minutes after the nearest approach of the fourth satellite, to observe the internal and external contacts of the first satellite at its egress from the disc."

London: Printed by G. Barclay, Castle St. Leicester Sq.

ROYAL ASTRONOMICAL SOCIETY.

Vol. XII. *December* 12, 1851. No. 2.*

J. C. Adams, Esq., President, in the Chair.

W. S. Bohn, Esq., York Street, Covent Garden; and
J. J. Waterstone, Esq., of Bombay,
were balloted for and duly elected Fellows of the Society.

Extract of a Letter from Professor Challis, dated Jan. 10, 1852.

"I have been at considerable pains to get at the truth about the supposed new planet, and last night I believe I succeeded. The object observed by Dr. De Gasparis, Dec. 8 and 9, must have been *Japetus*. By a rough calculation I find that the place of this satellite at that time, and its change of position relative to *Saturn*, sufficiently accord with the observations. This is the only satellite whose right ascension could differ as much as 30^s from that of *Saturn*. Although Dr. De Gasparis states that he took account of *Japetus*, I conceive that he must have mistaken *Titan* for *Japetus*, or perhaps some other object was supposed to be *Japetus*. M. Rümker's place is, I conceive, an observation of *Titan*. I ascertained this last night, having found *Titan* in the same position relative to *Saturn* which the object observed by M. Rümker had on Dec. 24; and the interval between Jan. 9 and Dec. 24 (16 days) is very nearly *Titan's* periodic time. I have seldom, perhaps never, seen the satellites of *Saturn* so bright as they now appear; and I am not surprised that *Titan* should be taken for one of the asteroids. It is a good 9th magnitude, and was visible, notwithstanding its proximity to *Saturn*, in the finder of our telescope."

VICTORIA.

Durham. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1851.	Green. M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	No. of Comps. in R.A.	No. of Comps. in N.P.D.	Set.
Nov. 4	12 48 54·8	8 14 18·22	77 16 3·0	8	4	1
18	12 29 48·7	18 8·23	78 23 28·0	12	5	2
22	13 39 29·8	8 18 20·51	78 40 54·4	24	8	3

* This *Notice* contains all the papers received up to the date of going to press. The January Number will consist of the purely *astronomical* phenomena observed during the solar eclipse of 1851, July 22.

1851.	Green. M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	No. of Comps. in R.A.	N.P.D.	Set.
Nov. 24	13 0 43·3	8 18 17·84	78 48 54·8	22	8	4
27	13 15 18·5	18 1·07	79 0 30·7	24	8	5
28	13 17 56·1	17 52·40	79 4 12·6	23	8	6
Dec. 21	13 2 12·5	7 14·09	80 2 5·4	24	8	7
22	11 28 0·2	8 6 31·25	80 3 14·8	24	8	8
	12 11 16·4	29·45	19·5	24	8	9

Parallax taken from the Supplement to the *Nautical Almanac*, 1854.

Assumed *Mean* Places of Stars of Comparison, 1851·0.

Name.	R.A. h m s	N.P.D. ° ′ ″	Set.
Weisse, viii^h, 381	8 14 55·90	77 20 22·8	1
— viii^h, 488	18 39·63	78 29 28·2	2
B.A.C. 2806	15 45·95	78 53 30·0	3, 4, 5, 6
Weisse, viii^h, 96	4 46·53	79 58 44·0	7, 8
— viii^h, 189	8 8 9·14	80 8 26·1	9

Sets 1, 2. Planet excessively faint, 12th magnitude. Great difficulty in observing it at all.

— 3 to 6. B.A.C. 2806 taken from Edinburgh Observations, 1837.

5 and 7. Sky foggy on these two nights.

Liverpool. Equatoreal. (Mr. Hartnup.)

1852.	Green. M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	Comp^d—Obs^d R.A. s	N.P.D. ″	Star of Comp.
Jan. 17	10 47 18·1	7 41 26·35	79 54 35·2	−4·19	−15·9	B.A.C. 2636
18	11 29 8·8	7 40 21·57	79 52 51·3	4·24	18·4	— —
	11 44 6·4	20·97	46·1	4·29	14·3	— —
	11 59 3·2	20·14	44·7	4·11	14·0	— —
20	11 34 9·5	7 38 16·19	79 49 7·9	4·28	16·7	— —
	11 52 5·9	15·27	7·0	4·14	17·1	— —
	12 10 2·5	14·42	4·5	4·07	16·1	— —
23	10 49 22·8	7 35 13·05	79 43 66·3	4·17	18·4	— —
	11 17 19·3	11·82	62·6	4·12	17·3	— —
	11 37 15·3	10·86	59·9	−4·00	−16·4	— —

The observations are corrected for refraction and parallax. The computed places were deduced from the ephemeris circulated by the Superintendent of the *Nautical Almanac.*

The following assumed *mean* place of the star of comparison for Jan. 0·1852, has been derived from various modern catalogues.

	R.A. h m s	N.P.D. ° ′ ″
B.A.C. 2636	7 47 28·80	80 44 53·3

PARTHENOPE.

DURHAM. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1851.	Green. M.T. h m s	R.A. h m s	Exc. of Ephem. s	N.P.D. ° ′ ″	Exc. of Ephem. ″	No. of Comps. in R.A.	No. of Comps. in N.P.D.	Set.
Aug. 28	12 17 15·4	2 19 22·56	+4·84	82 28 44·7	−26·9	18	6	1
30	12 15 51·3	19 55·39	4·49	32 18·0	28·2	12	4	2
Sept. 5	12 52 12·1	20 49·66	5·83	46 35·5	29·2	15	5	3
6	13 45 55·8	20 52·51	6·08	49 35·8	30·0	15	5	4
9	13 22 22·1	20 50·34	6·30	82 58 57·0	23·0	24	8	5
11	13 0 37·6	20 39·95	6·43	83 6 1·2	27·9	18	6	6
13	13 36 23·1	20 21·76	6·77	13 43·1	28·8	15	5	7
21	14 35 22·1	17 56·70	7·57	83 49 15·9	25·6	9	3	8
27	14 34 29·4	14 55·21	8·07	84 20 17·5	21·2	24	8	9
28	15 13 57·8	14 18·37	8·11	25 55·1	21·0	15	5	10
Oct. 4	14 32 55·2	10 14·70	8·09	84 59 52·1	21·5	8	3	11
11	14 11 17·0	4 36·07	8·31	85 40 47·9	21·0	24	8	12
	14 44 31·6	34·65	8·53	58·6	23·5	24	8	13
13	10 36 6·1	2 59·64	7·80	85 51 31·8	17·9	24	8	14
	11 14 49·3	57·69	8·32	45·0	21·8	24	8	15
	12 0 39·6	56·34	7·99	54·2	19·8	24	8	16
15	12 19 55·7	1 7·83	8·43	86 3 27·9	17·7	24	8	17
16	10 13 54·1	2 0 18·19	8·40	8 38·0	16·2	24	8	18
	11 11 46·9	16·19	8·20	53·4	18·0	18	6	19
19	12 7 47·1	1 57 28·73	7·91	25 47·7	17·3	12	4	20
23	10 32 58·8	53 49·60	7·59	86 46 33·0	16·8	24	8	21
26	9 36 3·6	51 5·49	7·49	87 1 1·7	13·4	24	8	22
	10 21 15·8	3·81	7·44	8·4	11·2	24	8	23
27	10 12 36·1	50 10·03	6·69	5 47·3	12·6	24	8	24
28	10 24 16·1	49 15·33	6·54	10 19·5	11·7	24	8	25
31	9 21 26·9	46 37·13	7·21	22 45·6	8·6	8	4	26
Nov. 2	10 5 34·6	44 52·71	7·01	30 35·2	11·3	24	8	27
3	8 54 25·9	44 4·85	7·06	33 59·0	10·9	24	8	28
4	10 46 30·6	43 12·01	6·70	37 39·9	11·5	21	7	29
12	10 36 2·4	37 18·20	5·83	58 8·0	7·1	24	8	30
13	11 27 48·4	36 37·92	6·03	87 59 55·4	8·5	24	8	31
18	9 29 18·3	33 49·14	5·64	88 5 23·8	9·3	16	8	32
22	12 16 5·7	31 56·33	5·60	6 14·4	9·7	15	5	33
24	8 4 41·9	31 15·44	5·30	5 32·1	10·5	24	8	34
	11 35 8·9	12·42	5·27	22·8	6·4	16	8	35
25	11 55 19·7	30 52·19	5·28	4 40·1	6·7	9	3	36
27	8 48 33·9	30 19·37	5·39	2 49·1	6·8	21	7	37
	10 18 43·1	18·41	5·36	48·8	10·9	24	8	38
28	10 32 29·6	30 3·52	5·17	88 1 28·1	7·7	24	8	39
Dec. 22	8 43 54·8	1 32 20·91	+5·30	86 39 55·1	−21·9	24	8	40

Parallax and computed places taken from Luther and Vogel's ephemeris given in the *Astron. Nachrichten*, No. 773.

The interpolations have been performed by second differences for the Greenwich time of observation, increased by the longitude of Berlin and diminished by the aberration-time; it having been inferred that the ephemeris gives *true* and not *apparent* positions.

Assumed *Mean* Places of Stars of Comparison, 1851·0.

Name.	R.A. h m s	N.P.D. ° ′ ″	Set.
Weisse, ii^h, 347	2 21 5·13*	82 17 25·4	1
— ii^h, 158	10 48·40*	30 35·9	2
— ii^h, 417	25 5·00*	82 46 25·4	3, 4
— ii^h, 309	19 1·19	83 2 56·7	5
B.A.C. 789	27 11·15	10 48·5	6, 7
— 793	27 55·05*	83 49 34·5	8
Anonym. 8th mag.	18 25·45*	84 22 43·0	9
Weisse, ii^h, 312	19 13·64*	84 26 36·7	10
— ii^h, 112	8 0·01	85 2 42·6	11
B.A.C. 687	5 42·48*	41 7·7	12
Weisse, ii^h, 27	3 9·03	37 16·1	13
— ii^h, 35	3 48·36	56 11·2	14
— ii^h, 102	7 12·41	49 40·5	15
— ii^h, 72	5 29·88	56 59·8	16
— ii^h, 51	4 14·39	6 42·3	17, 18
— ii^h, 78	5 57·94	9 56·4	19
B.A.C. 663	2 1 54·49	28 30·8	20
Weisse, i^h, 984	1 54 57·88	86 52 24·7	21
— i^h, 892	50 16·23	87 3 28·5	22
— i^h, 962	53 55·35*	2 11·7	23
— i^h, 860	47 54·06	9 14·0	24, 25
— i^h, 847	47 4·52*	20 24·2	26
B.A.C. 574	45 50·70	87 33 0·0	27, 28, 29
Weisse, i^h, 703	38 50·20	88 2 45·6	30
— i^h, 620	34 11·72*	3 5·5	31 to 34, 38
— i^h, 511	30 38·82*	10 26·3	35
— i^h, 489	28 12·41	88 1 52·7	36, 37, 39
— i^h, 540	1 31 14·25	86 38 9·7	40

Those stars which have an asterisk following their right ascension have been observed three times each on the meridian at Durham in right ascension. The corrections to the *Naut. Alm.* stars used at Greenwich have been applied in finding clock-errors. The north polar distances have not been corrected.

Set 1. Planet a good 10th magnitude.

— 4. Comparisons, from some cause, not very regular.

— 6 and 7. Star's place adopted from Rümker and Henderson.

— 8. B.A.C. 793. Right ascension observed on the meridian. North polar distance corrected approximately by equatoreal comparisons with four neighbouring stars in Weisse. This star appears to have a proper motion of about

$+2''\cdot 2$ in R.A., and $-1''\cdot 8$ in N.P.D.

Set 9. Star's north polar distance depends on that of Weisse, ii^h, 312.

— 11. Sky most changeable.

— 12. B.A.C. 687 appears to be 1^s in error in right ascension in catalogue.

— 20. Unfavourable night. Star's place taken from the Edinburgh Observations for 1837.

— 21. Unfavourable night. Foggy. Measures affected.

— 24. Objects furry. Atmosphere loaded.

— 26. Measures interrupted by haze coming on.

— 27. Excellent night. Star's place adopted from the Greenwich and Edinburgh Observations.

— 30. Star's north polar distance increased by 5″ after comparison with Weisse, i^h, 620.

— 35. Weisse, i^h, 511 requires 1^m to be added to its right ascension.

— 40. Star's north polar distance seems suspicious. Two unforeseen interruptions and unusually bad weather have prevented my examining this star and obtaining more observations during December.

PALLAS.

DURHAM. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1851.	Green. M.T. h m s	R.A. h m s	Exc. of Ephem. s	N.P.D. ° ′ ″	Exc. of Ephem. ″	No. of Comps. in R.A.	N.P.D.
Oct. 26	13 14 34·5	3 40 45·44	−1·59	114 6 13·9	−27·1	10	5
27	13 2 49·3	3 40 9·11	−1·77	114 22 43·7	−27·4	24	8

Parallax and computed places taken from the *Nautical Almanac*, 1851.
Star for both nights, B.A.C. 1191, taken from the Greenwich Twelve-year Catalogue.

	R.A. h m s	N.P.D. ° ′ ″
1851·0	3 41 15·12	114 20 23·4

The measures on the 26th were unfavourably taken, the planet being near the edge of a cloud. On the 27th well seen.

Extract of a Letter from Professor Argelander.

"I have not been able to find time as yet to complete my memoir on Flamsteed's Observations, my Southern Zones having hitherto occupied me exclusively. A large portion of this work is, however, prepared, and the printing has proceeded as far as the tenth sheet. I hope to complete it before the end of this year. To bring it earlier into the hands of astronomers, I purpose to divide it into three parts; but I can even now furnish star-positions from the MSS. The following places of the stars of comparisons, which

were used at Cambridge, Durham, and Hamburg, for *Irene* and *Eunomia*, will, I hope, give still greater accuracy to those excellent observations."

Mean Places for 1850 of Stars compared with *Eunomia.*

		Argel. Zone.	No.	Mag.	R.A.	Decl.
					h m s	° ′ ″
Cambridge	*b*	220	74	6	17 53 39·58	−24 16 29·9
—	-	222	57	7	39·77	30·7
—	*c*	220	80	7	17 55 58·43	−24 23 61·9
—	-	222	63	7.8	58·85	59·3
Hamburg	1	220	88	9	18 0 28·45	−24 43 60·6
—	-	222	71	9	28·45	59·1
—	5	220	95	9	18 4 21·34	−24 37 36·0
—	-	222	75	9	21·26	35·0
—	7	220	98	9	18 5 22·60	−24 36 8·5
Cambridge	*d*	220	101	8	18 7 24·33	−23 56 36·7
—	-	222	79	8	24·44	37·2
—	*e*	220	112	7.8	18 12 57·15	−22 59 5·8
Durham	3	224	63	7.8	57·47	5·5
Cambridge	*a*	222	84	7	18 12 17·43	−24 58 36·0
Hamburg	11	308	37	6	17·56	33·1
Durham	1, 2	222	90	8.9	18 16 2·62	−23 3 14·4
—	4	224	76	9	18 23 28·27	−22 23 37·3

Mean Places for 1850 of Stars compared with *Irene.*

		Arg. Zone.	No.	Mag.	R.A.	Decl.
					h m s	° ′ ″
Durham	*d*	297	32	7.8	15 28 7·22	−16 30 36·8
—	*e*	207	95	7	15 30 10·50	−17 10 3·7
—	-	297	36	7.8	10·17	2·4
—	*b*	205	48	7.8	15 34 20·50	−15 31 43·4
—	-	297	40	7	20·43	38·0
—	*c*	297	41	7.8	15 35 27·17	−16 23 20·5
Hamburg	1	207	105	8	15 38 45·91	−17 37 9·6
—	-	303	82	8.9	45·73	11·3
—	2	303	85	6.7	15 41 17·78	−17 26 19·7
Durham	*f*	207	110	7.8	15 41 18·11	−17 40 43·0
—	-	303	84	7.8	18·17	44·2
—	*g*	385	120	7	15 54 24·63	−19 25 5·0
—	*l*	386	116	8	16 15 28·94	−22 18 0·3
—	*m*	213	41	7.8	16 29 20·50	−22 34 60·1
—	-	382	32	8	20·21	58·7
—	-	386	33	7.8	20·82	57·1
—	*n*	213	43	8.9	16 32 12·13	−23 1 38·5
—	-	286	35	8.9	12·24	34·9

ENCKE'S COMET.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1852.	Green. M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	Compᵈ—Obsᵈ. R.A. s	Compᵈ—Obsᵈ. N.P.D. ″	Star of Comp.	
Jan. 11	7 14 17·4	23 4 6·86	86 2 3·0	−0·48	+6·3	B.A.C.	8105
16	6 58 32·2	23 10 1·69	85 34 60·7	·81	−4·3	—	8177
	7 18 30·4	2·68	57·3	·75	5·8	—	—
	7 38 28·4	3·38	56·8	·40	10·3	—	—
17	6 49 52·9	23 11 16·11	85 28 62·5	·24	2·4	—	—
	7 9 52·0	17·85	63·7	·90	8·7	—	—
	7 29 50·6	18·91	57·6	·89	7·8	—	—
25	6 41 15·3	23 22 11·10	84 35 33·3	·17	3·9	—	8233
	7 11 13·7	13·41	21·7	·63	1·5	—	—
	7 33 12·3	14·63	22·4	−0·51	−8·9	—	—

The observations are corrected for refraction and parallax. The computed places were deduced from the ephemeris circulated by the Superintendent of the *Nautical Almanac.*

The following are the assumed *mean* places of the stars of comparison for Jan. 0·1852.

	R.A. h m s	N.P.D. ° ′ ″	Authority.
B.A.C. 8105	23 9 29·58	87 31 31·9	Greenwich 12-years' Catalogue.
8177	23 20 27·71	84 26 0·0	— — —
8233	23 32 20·40	85 10 30·9	Greenwich Observations, 1849

The observation on the 11th was obtained during a very brief interval between clouds. The appearance of the comet was that of a faint patch of nebulous light of between 1′ and 2′ diameter. Notwithstanding its proximity to the moon on the 25th, it was very much brighter on that day than it was on the 11th.

MARKREE. Large Equatoreal. (Mr. Graham.)

	G.M.T. 1852.	R.A. h m s	Decl. ° ′ ″		
Jan.	17·30475	23 11 17·83	+4 31 26·2	10	*a, b*
	20·29675	23 15 11·68	+4 50 18·7	10	*c*

			R.A. h m s	Decl. ° ′ ″
a	B.A.C.	8127	23 12 46·59	+4 34 19·5
b	Weisse, xxiii, 252		23 12 36·59	4 30 14·3
c	Lalande,	45753	23 14 29·43	+4 41 35·8

The comet's places have been corrected for parallax, not for aberration.

These give for the correction of the *Nautical Almanac* places,

	s	″
Jan. 17	+0·28	+18·0
20	+0·31	+19·5

"On the 17th a third star of comparison was noted, but the place deduced from it,

h m s	° ′ ″
23 11 16·95	4 31 24·6

turned out to be nearly one second of time different in right ascen-

sion from those obtained by comparison with the other two stars, when I used Bessel's determination of the former, viz.,

1852·0	h m s	° ′ ″
Weisse, xxiii, 229	23 11 17·70	4 36 8·7

"This circumstance would have been puzzling had there been no other authority for the star; but, fortunately, it occurs both in Lalande and Piazzi as follows:—

1852·0	h m s	° ′ ″
Lalande, 45638	23 11 16·57	4 36 14·3
Piazzi, xxiii, 43	16·20	13·0

"There can be little doubt, therefore, that the star has a secular proper motion in right ascension of upwards of two seconds. I assumed, in the comparison, that the places given by Mr. Stratford in his ephemeris are *apparent*. At the time of the observation on the 17th, there was an impression that whatever little condensation of light existed was not central, but north-east of the centre. I cannot say, however, that this was confirmed on the 20th. On the latter occasion there were small stars in the coma, and I feared there were others in the brighter parts; the agreement of the observations leads me to hope such was not the case. Last night cleared up, but not early enough to see the comet."

Mr. Graham got observations of Encke's Comet on the 23d and 24th inst., and states that the proximity of a ninth-magnitude star troubled him very much; its light weakened that of the comet considerably. He adds that he never before had been so much impressed with the vapoury nature of such bodies, and that one could readily imagine that the comet of Encke could be compressed into the compass of a nutshell.

D'ARREST'S COMET,

With different Ring-Micrometers applied to the 5-foot Fraunhofer.

Bonn. (Professor Argelander.)

1851.	Bonn M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″
July 3	13 13 2·3	14 31 33·6	+10 47 3·0
5	13 37 41·9	16 42 41·2	49 3·1
6	13 21 9·8	17 46 6·6	49 20·0
22	12 26 54·0	33 43 35·7	+10 4 42·9
24	13 11 48·5	35 33 50·4	+ 9 53 7·5
25	12 50 52·8	36 26 20·2	47 1·4
27	13 5 36·6	38 11 3·8	33 36·2
28	12 46 56·2	39 1 27·5	+ 9 26 24·4
Aug. 2	12 42 6·5	43 5 45·5	+ 8 46 50·4
5	12 55 41·5	45 23 35·5	20 7·2
	13 25 0·4	84·3	8·3
7	13 32 49·8	46 52 23·3	+ 8 1 12·2

1851.	Bonn M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″
Aug. 21	13 41 25·3	55 39 42·6	+ 5 29 5·0
22	13 14 40·7	56 10 28·2	+ 5 16 52·6
25	13 34 4·4	57 40 53·9	+ 4 39 33·5
Sept. 2	13 29 41·8	61 4 36·0	+ 2 55 56·9
24	12 57 31·4	65 49 64·2	− 2 8 56·7
	13 9 36·8	38·0	53·9
27	12 32 9·6	65 57 18·9	− 2 49 58·0
	13 42 55·7	0·4	109·6
Oct. 2	13 17 59·8	65 52 57·4	− 3 57 9·7
3	14 6 14·8	65 49 52·4	− 4 10 31·0
	14 37 43·3	44·5	28·8
4	13 45 1·1	65 45 38·4	− 4 22 58·2

The following observations were made by M. Schmidt:—

Sept. 7	13 38 30·2	62 45 30·1	+ 1 47 18·0
8	15 52 25·4	63 4 29·1	+ 1 32 41·2

Solar Eclipse of January 31, 1851, observed at Paramatta by Captain P. King, R.N., with Notices of other Observations of the Eclipse in Australia.

This eclipse was observed at Newlands, Paramatta, by Captain King, in conjunction with the Rev. W. B. Clarke, whose account is given in vol. xi. p. 223. The northern limit passed almost exactly over Captain King's station, but most probably the annulus was not formed. On February 1st, the Paramatta date of the eclipse, the sky became clear after a longish series of indifferent weather. The telescope used was a refractor by Watkins and Hill, of $2\frac{3}{4}$ inches aperture and 44 inches focus, mounted equatoreally, the eye-piece *direct* and magnifying about 40 times.

First contact, $4^h\ 6^m\ 6^s$, Local M.T., within 3^s or 4^s.

When the eclipse approached its maximum phase, "The sky and terrestrial objects around were enveloped in a gloom of dull greenish hue, the moon's disc formed a huge black orbicular mass, suspended within a crescent of dazzling splendour,* while its lower edge seemed to be ploughing through a sea of fused metal. The cusps, which were attenuated to so acute an angle as to be scarcely definable, were so near each other and so rapidly approaching as

* Diameter of sun 32′ 29″·8 } Probably *tabular* diameters.
— moon 29 40·5

Captain King states the smallest breadth of the uneclipsed portion of the sun to be 3′ 6″·7, but not whether this was *measured* or computed, probably the latter.

to be apparently on the point of meeting, when suddenly the interval was filled by a *thread* of pale white colour, and their forward motion stopped. This appearance only lasted 3^s or 4^s, when the thread disappeared, subdued by the rapid increase of returning light, as the cusps receded from each other in the progress of the eclipse; for they separated from each other as rapidly as they had previously approached." . . . . "The junction, however, between the thread and the cusps was not quite complete; for immediately contiguous to the latter, their glare subdued the pale light of the *thread*, and beyond this small space, the darkened sky behind contrasted with it, and assisted to make it, to me at least, prominent and distinct, especially as the atmosphere on the horizon had become extremely clear." Captain King conceives that the annulus was never quite formed, but that the edge of the moon, enlightened from behind, filled up the gap with the *thread*.

"During the time when the cusps were so rapidly advancing and receding with respect to each other, the appearances known as Baily's *beads* were visible in their angles for some time. They resembled bubbles protruding from, and again dissolving in, the dark edge of the moon's limb; and at one time a black band appeared in a longitudinal direction, bisecting the angle of one of the cusps." Captain King refers to Mr. Clarke's account, the substance of which is given, vol. xi. pp. 224, 225. At the same place will be found the meteorological observations made by Mr. Clarke. The numerous spots on the sun were carefully measured by Captain King (a well-executed drawing accompanies the paper), and he noted the times when these spots were covered by the moon's limb; but as no corresponding observations were made, these observations are not given.

Last contact, $6^h\ 31^m\ 35^s$, Local M.T.

At Newlands, the place of Captain King's observations, the Paramatta Observatory bears N. 88° 50′ W. (true); distance, 6189 feet; which, with compression $= \frac{1}{304}$, makes Newlands $1''\cdot 2$ S., and $4^s\cdot 89$ E. from Paramatta. Hence, using the position of Paramatta in the *Nautical Almanac*,

Newlands is in lat. 33° 48′ 51″ S.; long. $10^h\ 4^m\ 11^s$ E.

Observations at Melbourne; *Province*, Port Phillip.*

Latitude 37° 49′ S.; longitude $9^h\ 39^m\ 50^s$ E.

Mr. Latrobe, the lieutenant-governor of the province, kindly undertook to have the eclipse observed at Melbourne, which was nearly on the central line. Mr. Latrobe says, "The character of the light and its effect on the shadows were remarkable, but not easy to describe. The shadow of the stems of trees appeared streaky, and ill-defined on one side; that of leaves seemed surrounded by halos. The barometer was uninfluenced; the thermometer fell 5°, and afterwards rose 3°."

* This name is to be changed to Victoria.

Observations at Melbourne, by MM. Grover and Robertson.

1851.		h m s	
Feb. 1	First external contact	3 27 56	Melbourne M.T.
	— internal —	4 47 44	— —
	Last — —	4 52 48	— —
	— external —	6 2 3	— —

Observations at Sydney, *by* Mr. A. Longmore.

Latitude 33° 53′ 30″ S.; longitude $10^h\ 5^m\ 26^s$ E.

1851.		h m s	
Feb. 1	First contact	4 7 44	Sydney M.T.
	Last —	6 32 58	— —

Observations at Yarrowlumla, *by* Mr. Murray.

Latitude 35° 19′ S.; longitude 149° E.

The following is the substance of Mr. Murray's account:—"The annularity was decided here. We were evidently considerably within its northern limit, as the annularity lasted exactly 3^m. The disc of the moon appeared streaked by five stationary lines; its surface appeared rough. There was a slight glow of light over its dark face, on the upper part; its edges were uneven all round, but presented no striking irregularities. When the moon had passed over about a third of the sun, a deep crimson glow seemed to pass over his face, extended to the upper cusp, and then disappeared. On three occasions the cusps of the sun seemed blunted; but perhaps a little fatigue of the eye may account for all these appearances."

"At the commencement of the eclipse the thermometer in the shade stood at 82°, and, when exposed to the sun, at 93°. It fell during the annular phase to 77°, and by the end of the eclipse had risen to 86°."

Using Mr. Woolhouse's formulæ and the data of the *Nautical Almanac*,* Captain King has computed the following longitudes:—

		h m s	
Paramatta	By beginning	10 4 14·3	East.
	— end	10 3 58·3	—
Melbourne	By beginning	9 39 52·6	East.
	— end	9 39 54·1	—

On the Determination of Elliptic Orbits. By M. Benjamin Valz.

In the *Connaissance des Temps* of 1835, the author gave a method for calculating directly the orbits of comets, sufficient for obtaining the first approximation to the elements, to be rectified afterwards

* It must not be forgotten that the data of the *Nautical Almanac* can only be relied upon within the limits of accuracy of the Solar and Lunar Tables, which are as yet far from perfection.

by the calculation of the interval of time. It remained for him then to apply the same method to the determination of elliptic orbits, the number of which is constantly increasing, both by the discovery of additional small planets and comets of short period.

M. Valz takes the opportunity to clear up an historical difficulty relative to the first methods employed in the calculation of the orbits of comets, and to give some proof of what he had advanced in the preceding memoir, viz. that Bradley appears to have employed in his calculations the same steps, followed by Lacaille afterwards, without any other modification than some differences in the mode of computation.

He cites several passages from Delambre's *Astronomy of the Eighteenth Century*, and endeavours to prove that the latter has inadvertently misrepresented, in some degree, the methods of Lemonnier, which, when properly understood, tend to prove the author's views respecting Bradley's methods.

M. Valz then proceeds to explain his method of computing elliptic orbits, referring for the basis of the method to the memoir in the *Connaissance des Temps*. He gives formulæ by means of which, with the assistance of a table appended to the memoir, the true distance of the planet or comet from the earth can be computed; he then gives formulæ for computing the values of the radii-vectores, and the difference of the extreme anomalies: and, finally, for the computation of the elements of the orbit.

For more readily obtaining the excentric from the mean anomaly, he gives, for every 10° of excentric anomaly (x), a small table of the values of $\frac{\sin x}{\sin 1''}$; he adds also a table for determining the limits and extent of the double solution in the determinations of orbits.

Finally, he gives an example of the application of the method, with the computations in detail.

Extract of a Letter from Mr. Graham, of Mr. Cooper's Observatory, Markree Castle.

"A continued effort, during the past year, to determine the places of as many new stars as possible for insertion in our maps, and the consequent necessity for taking advantage of every favourable opportunity, in a climate where such seldom occurs, will account for our having done so little in the way of observing planets and comets. In the examination of comets especially, excellent as are our instrumental means, little can be done. Many, and among these some of the later ones, have escaped us altogether. Our observing nights commonly fail about 10 or 11 o'clock: we are hence obliged to begin our regular work as soon as it is dusk enough for our purpose. We have pursued our object steadily, and have, notwithstanding all the disadvantages of climate, been able to make some progress toward its accomplishment.

"With our proceedings up to the end of 1850 you are fully acquainted. The places of nearly 15,000 stars have, at the expense of the Government, been given to the public.* Situate in the most interesting zone of the heavens, and all, with an occasional exception, previously undetermined, it is hoped that this tribute to science will not be without its value. From the observations taken last year, we are able to make a gross addition of upwards of 12,000 stars. These are not all new, but the number of known stars included will not materially affect the total. The observations experience so many interruptions that the reductions nearly keep pace with them, and we shall soon be in a condition to arrange these stars also in a catalogue.

"Nearly all the stars known, from published catalogues or from our own observations, within the prescribed limits, have been inserted in maps, through 9 hours of right ascension. Each map embraces 8° in right ascension, and as much in declination. Their scale is four times larger than that of the Berlin maps, that is to say, nearly two inches to a degree. All the stars can thus be inserted without presenting a crowded appearance, and their magnitudes to the 12th distinctly exhibited. The epoch is 1850·0. The labour of reducing the stars of Bessel, Lalande, &c., up to this epoch, which is done with all requisite regard to accuracy, is by no means light.

"We are well aware that, in adopting this course, we are labouring for the future advantage of other astronomers rather than for greatly facilitating our own researches. To keep up anything like a constant survey of the heavens where, for weeks together, neither sun nor star is visible, is out of the question.

"I should mention that arrangements are made whereby, it is hoped, our contributions to your valuable *Notices* during this year shall be more regular. Mr. Cooper, with his wonted munificence, has had an eye-piece executed for the large equatoreal, which promises to be of considerable advantage in extra-meridional observations. With a considerably higher power than we have ordinarily used, it gives a larger and flatter field, and a very sharp definition. An adapter for the examination of solar maculæ has lately been applied by Mr. Cooper to his telescope. It is furnished with a drum of 9 inches diameter, containing alum water between parallel glasses. With the aid of this appendage, Mr. Cooper observed the late solar eclipse, using the whole aperture of the telescope, having no further defence than a pair of dark spectacles.

"In addition to the valuable personal assistance afforded by Mr. Cooper, as well in superintending the operations as in actually observing and preparing the stars for the catalogue, he has nearly concluded the transcription of his notes on comets for the printer. His catalogue of cometic orbits, containing upwards of 200 appa-

* Catalogue of Stars near the Ecliptic, observed at Markree during the years 1848, 9, 50, and whose places are supposed to be hitherto unpublished. Vol. i. containing 14,888 stars. Printed at the expense of her Majesty's Government, on the recommendation of the Royal Society, Dublin, 1851.

ritions, with notes, is now ready for publication. This work not only contains a complete list of the best orbits of all the comets which have been computed, but also extensive notes relative to the physical phenomena, &c. which have been remarked in these bodies, along with copious references; it will thus be a complete manual of what is known on the subject up to the present time. I allude to these facts to show that it is not merely for the large pecuniary outlay which such an institution involves that astronomy is indebted to Mr. Cooper, but, in addition, for his personal and unwearied exertions."

On the Longitude of the Observatory of Durham, as found by Chronometric Comparisons in the Year 1851. By Mr. R. C. Carrington.

When the observatory was first established, in the year 1841, its approximate longitude was found by trigonometrical measurement of its distance west from the cathedral, as given in a general survey; and $6^{m}\ 18^{s}$ west, neglecting portions of a second, was adopted to start with: this value appears in the *Nautical Almanac*. By observations of the moon and moon-culminating stars in the years that followed, it was found that $6^{m}\ 19^{s}$ was nearer to the truth, but there still remained an uncertainty of more than half a second. At the last meeting of the Observatory Syndicate, in the year 1850, it was decided that a determination by chronometric comparison should be forthwith obtained. The Astronomer Royal was written to, and granted his permission for the necessary access to the transit-instrument at Greenwich; and application was made to Messrs. Reid, of Newcastle, for the chronometers. Six were sent, three pocket and three marine box-chronometers: the latter only were found, on trial, to be suitable for the purpose. They were received on Jan. 4, 1851, and rated daily till the 17th by comparison with the transit-clock. The first up-journey was made on the night of Jan. 17, the first down-journey on the 27th, by railway, the chronometers lying, in the interval, in the chronometer-room of the Royal Observatory, and rated daily along with those on trial for the Admiralty. I secured a sufficient number of clock-stars before leaving Durham, on arrival at Greenwich, before departure, and after arrival on the return; so that the first journey was rendered independent of personal equation. The second journey up was made by night mail-train on Feb. 4. I arrived at Greenwich on the 5th, at $2^{h}\ 1^{m}$, and returned to Durham the same night, the state of the sky at Greenwich giving no hopes of obtaining observations for clock-error. Transits were obtained at Durham on the 4th, before departure, and on the 6th, after return; so that the second journey is affected only by a slight uncertainty in the assumed rate of the transit-clock at Greenwich, and in the personal equation applied.

My personal equation was determined by the transit-observa-

tions taken at Greenwich on Jan. 18 and 27, and is, as expressed in the Preface to the *Greenwich Observations*,

Dunkin — Carrington = + $0^{s}\cdot10$.

In the reduction it has not been attempted to determine travelling rates: it has been assumed that the vibration of the journeys caused equal deviations from the stationary rates of the time. The effect on the result, on this assumption, disappears in the mean of one up and one down-journey of the same chronometer. For the first journey two rates were employed, one for the up, another for the down-journey; for the second, one rate was found to be sufficient. These stationary rates were adopted from those immediately preceding and following the times of travelling. To the individual results weights were applied, inversely proportioned to the irregularities of rate of each chronometer, as follows:—

First Journey, by Hornby...	771	West	6 m 20 s·16	Weight	1
— — Reid......	1109	—	19·70	—	5
— — Harrison	476	—	19·84	—	1
		Mean, West	6 19·79		
Second Journey, by Hornby...	771	West	6 m 19 s·63	Weight	1
— — — Reid......	1109	—	19·71	—	2
— — — Harrison	476	—	19·78	—	2
		Mean, West	6 19·72		

The two results are considered to be of equal value, and

$6^{m}\ 19^{s}\cdot75$ West

is received as the final result, by chronometric comparison, for the longitude of Durham Observatory.

The three chronometers travelled in a deal box, well padded with horse-hair stuffing, made sufficiently low to go under the seat of a first-class railway carriage. The box rested steadily on three padded feet, and was carried between two men to and from all carriages. The chronometers were clamped in their gimbals while travelling, and appear to have been wonderfully little affected by the vibration they were subjected to. The calculations are preserved at full length at the observatory.

The communication of the result has been delayed since March 1851, in expectation of our being able to compare it with the geodetic longitude determined by the Ordnance Survey, but that result has not yet reached us.

P.S. Brorsen's Fifth Comet was carefully sought here on at least six different nights, but without success.

An Account of the Transit Circle at Mr. Drew's Observatory, Southampton, and of the Adjustments applied to it and to the Equatoreal. By Mr. Drew.

This transit circle is by Mr. Thomas Jones, and was made fifteen years ago. The telescope has $3\frac{1}{4}$ inches aperture, and $3\frac{1}{2}$ feet

focus; it will show the companion of *Polaris* in a dark field. The axis is 30 inches long, the Ys rest on stone piers, and the three microscopes for reading the divisions are fixed on a stone triangle at 120° from each other.

The telescope has five fixed transit wires, and one horizontal wire for north polar distance. This last is carried by a micrometer.

As the observatory is small and the instrument heavy (weighing about $1\frac{1}{2}$ cwt.), and as, from the arrangement of the microscopes, the reversal of the instrument would be inconvenient and dangerous, Mr. Drew has not attempted that operation. He thinks there may be some doubt as to the advantage of reversal in heavy instruments.

A collimating telescope of 1·6 inches aperture and 20 inches focal length is placed on a solid brick pier to the north, and outside the observatory, so as to be in the same line with the transit telescope, when horizontal. Mr. Drew does not find this much to be relied on as a *permanent* point of reference; but it is of great use for adjusting the instrument, considered as a well-defined mark. This collimator has a cover to protect it from the weather; and by opening a slide in front, and turning back the shutter behind to an angle of 45° (the shutter being whitened), distinct vision of the cross wires is obtained by day. At night the wires are illuminated.

To place the transit wires at right angles with the axis, it is sufficient to make the centre wire, through its whole length, pass over the cross of the collimator.

The intervals of the wires were determined by measuring them by the telescope and micrometer of the equatoreal (dismounted for that purpose), and also by transits of δ *Ursæ Minoris*. Mr. Drew gives a preference to the former method, which may admit of some question; but the two methods agree so fairly, that neither can be sensibly in error. The middle wire and the mean of the wires do not differ more than 0″·5.

In determining the error of collimation Mr. Drew has had more difficulty, and has not as yet been quite successful. He attempted to apply Bessel's method, viz., by taking out the object-glass and eye-piece of the transit telescope, and placing a telescope to the south of the instrument, in the same line with the collimator, so that the two are reciprocally collimators to each other. These being adjusted, and the object-glass and eye-piece inserted in the transit telescope—if the centre wire of the transit be made to bisect the wires of both the collimators, the collimation error is destroyed. From some want of steadiness in the position of the southern telescope, the attempt did not succeed; but Mr. Drew observes that this would be worth a trial with both telescopes on fixed piers.*

There are two ways of ascertaining the horizontality of the transit axis: first, by applying the level in the usual manner, which

* As in the Greenwich transit circle.

implies, however, that the pivots are equal; and secondly, by observing the coincidence of the central transit wire with its image seen in a mercurial horizon,* which also implies that the error of collimation is destroyed. Though the errors follow different laws, it would not be easy to separate them, very nicely, by observation. It is not probable that in a carefully-made instrument the difference of the pivots should be large, as the grinders ought to be used alternately for each; but without reversal, or without two collimators, it does not seem practicable to assign the relative errors correctly by the means adopted, unless the equality of the pivots can be assumed.† Mr. Drew has applied his level, and observed the coincidence of the transit wire with the image; the collimation, therefore, must correspond to the difference of the radii of the pivots, and cannot well be large enough to affect the accuracy of ordinary observations.

The meridian error is deduced, as usual, by observations of the upper and lower culminations of *Polaris*, and by opposite culminations of *δ Ursæ Minoris* and *Cephei* 51 Hev.

A specimen of the clock-errors, deduced from standard stars at different north polar distances, shows that the time at Mr. Drew's observatory is obtained with great accuracy.

In using the transit circle as an instrument for determining north polar distances, Mr. Drew relies on the nadir point, as determined by the coincidence of the horizontal line and its image seen by reflexion. He speaks with great confidence of the steadiness and consistency of this determination. The latitude of his observatory, deduced in this way from 9 Greenwich stars, is $50^\circ 54' 34''\cdot4$ N., probable error $0''\cdot42$; while the latitude derived from a triangulation connecting his observatory with the Ordnance Map Office gives $50^\circ 54' 34''$. (The longitude, derived in the same manner from the Map-Office data, is $1^\circ 24' 25''\cdot8$ W.‡)

Mr. Drew gives a brief account of the manner in which he has adjusted his equatoreal; as nearly, that is, as the instrumental readings enabled him.

The altitude of the polar axis, and the collimation of the telescope in polar distance, are corrected by observations of standard stars near the meridian, and in reversed positions of the instrument. The azimuth is set right by making the instrumental polar distances of standard stars six hours from the meridian§ agree with their tabular north polar distances.

The error of collimation in right ascension is obtained by observing the passage of stars near the equinoctial over the central

* Mr. Drew's instrument is provided with the proper eye-piece for this observation, and the means of illumination both by day and night.

† A guage might show the equality of the pivots, and *perhaps* measure their difference.

‡ The Ordnance Survey Longitudes, since a more correct figure of the earth has been adopted, seem to agree perfectly with the best astronomical data. See the "Memoir of the Astronomer Royal on the Longitude of Valentia," *Mem. Royal Ast. Soc.*, vol. xvi. p. 55.

§ Correcting, of course, for refraction, which is always supposed. Mr. Drew has given a formula *for the effects* of refraction, but it does not appear so convenient as that adopted in the Greenwich Observations.

transit wire, in reversed positions. A comparison of the intervals of the transits in the two positions with the difference of the readings of the hour-circle, gives the correction of the collimation; and if the stars are standard, and the error of the clock known, the correction of the verniers of the hour-circle may be deduced from the same observations. Finally, the squareness of the declination axis to the polar axis* is proved by ascertaining, whether stars which differ in polar distance give the same clock-error. By applying these precepts in order, Mr. Drew shows that he has been able to put his equatoreal into as perfect a state of adjustment as he has means for ascertaining its errors.

Letter from the Rev. Mr. Read respecting the Luminous Bodies seen on Sept. 4, 1850. (See *Monthly Notices*, vol. xi. p. 48.)

"At the suggestion of several eminent members of the Society, I beg again to call your attention to the account of the phenomenon of shooting stars, as seen by myself and my family, in the day time, on the 4th of September, 1850.

" My former communication, which appeared in the *Monthly Notice* of December 1850, was a very brief one, and was only intended to call forth the observations of others, had any such been made; and I omitted then, purposely, to append any attestation of those who witnessed it with me, or to state anything that might be unnecessary, in the hope that more full accounts might be furnished.

" I have, however, now laid before the Council such necessary attestations; and, in addition, offer a few such particulars as seem necessary to render my former communication more complete.

" I have myself been a diligent observer for about twenty-eight years, with instruments of a superior order; but I never witnessed any such appearance before.

" The occasion of my being in the way of seeing so remarkable a phenomenon was, that I had been engaged for several previous days, in succession, in observing with my equatoreal the planet *Mercury*, in order to ascertain how nearly I could trace his approach to the sun; and it was the first instant that I adjusted the instrument that I saw the appearance which I describe.

"I was, at first, filled with surprise, and endeavoured to account for what I saw by supposing that bodies were floating in the atmosphere; but nothing was visible to the naked eye, while the sky was perfectly cloudless and serene: the ceaseless passing of perfect spheres of light in uncountable numbers soon convinced me of the reality of the phenomenon, and I called in haste the various members of my family to witness it, which they did, with me, for many hours.

* Careful artists frequently make this adjustment themselves, and leave no power of alteration. When the polar axis is vertical, it is easy to make the declination axis horizontal; and when all the parts are sound and the work true, this adjustment is not likely to be altered. The application of a level is seldom *convenient for a mounted* equatoreal, but this adjustment may be performed by a *level.*

"The bodies we observed were all perfectly round, with about the brightness of *Venus*, as seen in the same field of view with them; and their light was white, or with a slight tinge of blue.

"The time they occupied in passing was, as nearly as I could estimate, about one-fourth of a second of time; but they showed no tail of light, such as seen in the case of shooting stars by night.

"They did not cease for a minute, passing often in inconceivable numbers, from the time I first saw them, viz. about half-past 9 A.M. to about half-past 3 P.M. when they became fewer, passed at longer intervals, and then finally ceased.

"There was nothing remarkable at night, that I saw; but having prepared the equatoreal on the following day, which was equally favourable for observation, I observed *one* body pass, precisely similar to the vast number we had observed the day previous.

"They occupied a zone, as nearly as I could judge, about 18° in breadth; and as both *Mercury* and *Venus* were visible by the telescope, I had an opportunity of comparing them with these planets; both of which presented a remarkable difference to the bodies crowding through the field of view.

"I expected that the appearance would be witnessed by many observers, and delayed for some days noticing the circumstance to any other astronomers; but not finding any remark on the subject in the newspapers, I then stated the occurrence to Mr. Hind, of the South Villa Observatory, who thought it of sufficient importance to be communicated to the Society.

"On comparing the phenomenon we witnessed with that observed at Boston, U.S. by Messrs. Olmsted and Palmer, as noticed by Capt. Smyth, in his *Cycle*, vol. i. p. 164, and by Baron Humboldt, *Cosmos*, vol. i. p. 112, there appears an entire similarity between them, with the exception of what we saw occurring in the day, while the phenomenon they witnessed was during the night.

"These gentlemen compared what they saw to flakes of falling snow, and nothing could better describe what we witnessed, allowance being made for the greater brilliancy of daylight, which diminished their intensity of lustre; but being seen upon the deep blue vault of heaven, they presented an appearance of beauty and interest never to be erased from the memory."*

Rule for the Signs of the Terms in the Equation of Equal Altitudes. By Capt. Shadwell, R.N. F.R.A.S.

"An idea has recently occurred to me with reference to the formulæ for the 'Equation of Equal Altitudes,' which perhaps you may think worthy of notice.

"I have observed that many persons are at fault when called

* The remark appended by the Editor to Mr. Read's former letter is shown by the present Letter to be erroneous, and must be withdrawn. It is, perhaps, not impossible that even an experienced observer should have been misled by some cause which temporarily affected his vision; but the luminous bodies, seen by Mr. Read, being also seen repeatedly, and for hours, by two members of his own family accustomed to the use of the telescope, and also by a visitor, negative any such explanation.—*Ed. N.*

upon to recollect the signs of the corrections of the two parts of the 'Equation of Equal Altitudes;' and it has occurred to me that a convenient technical rule might be given, apparently independent of any mathematical condition whatever.

"Most of the writers on navigation express the rule in such terms as apparently to involve several distinctions of cases.

"The rule, as it is very clearly expressed in Riddle's *Navigation*, is as follows:—

"'The first part, that under log A, is + when the polar distance is increasing, and — when it is decreasing. And the second, that under log B, is — when the polar distance is acute and increasing, or obtuse and decreasing, and + when the polar distance is obtuse and increasing, or acute and decreasing.'

"A brief examination of these conditions will show that the following law prevails:—

"The sign of the first part is positive from the summer to the winter solstice, and negative from the winter to the summer solstice.

"And that of the second part, positive from the equinoxes to the solstices, and negative from the solstices to the equinoxes.

"The polar distance in Mr. Riddle's rule is supposed to be always measured from the elevated pole, and the above technical rule will hold equally good in both hemispheres, provided we agree to understand the terms summer and winter solstices in their *natural* sense, according to the actual seasons at the places of observation, and not in that technical sense which the monopoly of astronomical observation in the northern hemisphere has caused astronomers to attach to them.

"It will thus be observed, that the signs of the two parts of the equation can thus be expressed independently of any mathematical condition whatever, and may be viewed merely as simple functions of the seasons of the year."

Solar Spots.

Captain Shea, of the H.I.C.S. has presented the Society with a continuation of drawings of the solar spots during the past year. The drawings are in a book, in a very regular method, and easily referred to. There are drawings, too, of several phases of the late solar eclipse with the times annexed.

Capt. Shea seems to be of opinion that the spots are bodies *detached* from the sun, and thinks that this is supported by some of the phenomena witnessed during the late eclipse. This idea was, if we remember, satisfactorily refuted by Galileo, and certainly has since received no increase of evidence in its favour.

Mr. Joseph Turnbull, of Kentish Town, has presented to the Society a very full series of drawings of the sun from March 22 to October 2, 1851. They were observed with a refractor of $2\frac{1}{2}$ inches aperture, power 45. The scale is rather small.

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ROYAL ASTRONOMICAL SOCIETY.

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J. C. ADAMS, Esq., President, in the Chair.

Hugh Lee Pattinson, Esq., Newcastle-on-Tyne;
Rev. Thos. Wm. Webb, Granarew, near Monmouth;
Wm. Johnson, Esq., Thame;
Edward Hughes, Esq., Greenwich Hospital School;
George Henry Strutt, Esq., Melford House, Derby;
Colonel Lloyd, Surveyor-general of the Mauritius,
were balloted for and duly elected Fellows of the Society.

Solar Eclipse of July 28, 1851.

In the present *Monthly Notice*, the Editor has attempted to include the principal *astronomical* phenomena which were observed during the solar eclipse of July 28, 1851, and of which accounts were sent to the Society. It is the intention of the Council to publish these memoirs at length in the 4to. volume; but so much interest has been taken in certain peculiarities attending this eclipse, that an earlier, though very partial, publication, has been deemed expedient.

In the total eclipse of 1842, observed by MM. Baily and Airy in the north of Italy, certain rose-coloured mountains were observed upon the limb of the moon, which are well expressed by the plates illustrating the memoirs of those gentlemen (see *Mem. R. A. Soc.*, Vol. xv., pp. 1, 18, plates I. and II.) These prominences are sufficiently described by calling them conical, and, perhaps, on the whole, of greater height than breadth.

In the recent eclipse several of these conical prominences were seen; and many of the sketches made by the different observers may be sufficiently reproduced, with a little attention, from *description.*

Some observers denote a situation on the moon by the angle measured along the circumference of the moon, from the north point of sun to the object. The reader, therefore, to comprehend the description, must draw a circle, graduate it to 360°, and then at the angle mentioned, erect and colour the prominence according to the text. If the division 0° be at the top, the appearances will be as if seen by the naked eye, with the *west* or *preceding* on the right hand, and the *east* or *following* on the left. If this figure be turned upside down, the appearance will be that seen in an astronomical telescope. (See Mr. Dawes' sketch in the accompanying plate).

Again, if a point somewhere about 30° or 35° be taken to the east of the north, this will be tolerably near the *vertex* or upper limb of the sun. Some of the observers refer the places of the prominences by angles measured from the *vertex* to the east or west. If the vertex be placed below, the appearances are such as would be seen in an inverting telescope. In the plate the appearances are figured in their natural position, as seen by the naked eye.

The eclipse commenced on the west side of the sun, and finished on the east. Generally, the disappearance took place in the east, and the reappearance on the west.*

The figure which represents the total eclipse, is taken from a sketch by Mr. Dawes, which included rather more than any other which has come into the Editor's hands. It is not to be considered as the state of the eclipse *at any one time*, but as containing all the appearances which were seen during the eclipse at any time, and at their respective *maxima.*

Mr. Hind's drawing is in all essentials precisely similar to Mr. Dawes', except that the southern *sierra* is continuous in Mr. Hind's, and interrupted in Mr. Dawes's sketch. Mr. Airy saw the western, but not the eastern portion of this sierra. It does not seem to have been distinctly recognised by any other observer.

The *conical* prominences, and even the prominences with two summits, may easily be drawn in their proper places by description, and by the figures in the *Memoirs* of MM. Baily and Airy, already referred to, or by Mr. Dawes' sketch; but the peculiar appearance of one prominence has been remarked by every observer, though there is a considerable difference in their descriptions and sketches. An attempt has been made to represent this appearance in the fifteen figures which are given in the bottom of the plate, and which are all intended by their authors to be portraits of the same individual. Conceiving these to be detached and applied to the limb of the moon at the angles assigned by the observers, it will not be difficult to create a tolerable picture of the eclipse as seen by each person.

In figuring the corona there is much greater discrepancy than in describing it: no attempt has been made to give any idea of this accompaniment beyond the words of the beholders. The description of the phenomena of Baily's beads must be looked for in Mr. Baily's paper, *Mem. R. Ast. Soc.*, vol. x., plate I.†

The physical and picturesque observations have been very briefly noticed, as they will appear in the quarto volume, and would have extended this *Notice* beyond due bounds. At the Island of Bue, the Norse fishermen showed great terror; at Trollhättan Falls, the observers within doors were almost scandalised by the uproar of those without; at Göttenburg, all sounds of labour ceased during

* As the publication is intended for many persons who are *not familiar* with astronomy, this very rudimental information may have its use.

† *Figures* 1, 2, and 3 of this plate were seen by several observers on the present *occasion*, *but* not the distortion of the moon's limb, as in fig. 4.

the darkness; and not far from Christiania, Lieut. Krag observed an old woman, who merely lighted her candle and continued her work. At Lilla Edet, people seem to have put on their best clothes.

Among animals,—dogs, horses, and cows, seem to have felt a little surprise, but not so much as to divert their attention from food: a calf formed some exception to this rule. The wild birds, which were surprised by the sudden darkness, seemed utterly at a loss, and were distressed, while the domestic fowls treated it as they would have done a natural close of one day and the beginning of another. Flowers showed the night phenomena.

There are two remarks, in which *all* the observers agree; first, in the strangeness, grandeur, and impressiveness of the spectacle; all express their gratification with the sight, and think they were repaid for their trouble: secondly, all return thanks for the hearty and kind manner in which they have been received by Dane, Swede, and Norseman. Professor Hansteen and Mr. Crowe at Christiania, Mr. Mygind at Lilla Edet, Lieut. Pettersson at Göttenburg, and Colonel Silverstopfe at Christianstadt, are gratefully and particularly thanked for their assistance and countenance.

The angles are sometimes stated by the observers, sometimes guessed by the Editor from the sketches. Mr. Swan's, and probably Mr. Dawes' angles, may be considered as more accurate than the rest. The observations follow in geographical order, from which it was hoped that something might be elicited. The consideration of most importance seems to be the parts of the moon's limb at which the sun disappeared and reappeared.

Island of Bue.

Latitude, 61° 9′ 42″ N.; Longitude, $0^h\ 17^m\ 24^s$ E.

Observations by Professor P. Smyth.

These observations were made in company with Dr. Robinson and several other gentlemen. The Commissioners of Northern Lights allowed their steamer to make a *detour* from their periodical visitation of the Shetland lighthouses; and the officers of the ship, and the scientific gentlemen who embarked for the purpose of observing the eclipse, were fully equipped with telescopes, chronometers, &c. from the stores of the Admiralty and from the observatories of Armagh and Edinburgh.

The steam-boat reached her point of destination (the island of Bue, which is the outermost of the series which line the Norwegian coast, and about 60 miles north of Bergen) on the morning of the day of the eclipse. Sights for time were got by sextant and artificial horizon about 10 A.M., and about noon for latitude. As the rate and error of the chronometer had been obtained at the Edinburgh observatory, the longitude and latitude above given were deduced from the sextant observations.

The clouds which covered the sun more or less during the eclipse prevented an accurate observation of the commencement of the

eclipse: the totality was apparently well observed, but it will be seen that there is a startling difference between the observers.

	Local Time.	Greenwich Time.	Observer.
	h m s	h m s	
Commencement ...	2 11 57	1 54 13	Prof. P. Smyth, too late.
Totality	3 12 37	2 55 13	Dr. Robinson.*
——	3 12 42	2 55 18	Dr. Robinson.*
——	3 14 33	2 57 9	Prof. P. Smyth.

The clouds now came on so thick that no further observation could be made.

After Dr. Robinson's signals were given, Professor Smyth continued to see the sun's crescent of a very visible breadth and well defined, but faint through clouds; at Dr. Robinson's signals sudden *depressions* in the *brightness* of the surface were perceived, and when Professor Smyth himself gave the signal for the totality, the limb seemed to vanish at once, though it had still a sensible breadth and was well defined.

"These variations may have been caused by passing clouds;" but Professor Smyth is inclined to think, "from their instantaneity, that they were produced by variations in the solar light itself, and that these variations were rendered more sensible, as the sun was almost obscured by a thick cloud." The Astronomer Royal accounts for his having seen the commencement of the totality of the eclipse of 1842 twice over, from the different specific brightness of the body of the sun and his extreme edge.† If we consider the cause of the difference to be in the cloud, though the observers used telescopes of the same aperture, Dr. Robinson had a power of 120 and Professor Smyth one of only 48, and Dr. Robinson's stand was somewhat rickety, while the Professor's was very firm, and loaded with heavy weights to keep it steady.‡ Indeed, from the visible and well-defined breadth of the strip of the sun at the moment of totality, as noted by himself, Professor Smyth has no doubt that the phenomenon would have occurred later, if the atmosphere had been clear or the telescope a more powerful grasper of light.

Thermometrical observations were made, but from the state of the sky cannot be considered of much value. There was a break in the north horizon, through which snow mountains were seen, probably 100 miles off.

The atmospheric appearances have been very strikingly exhibited by Professor Smyth in six water-colour drawings, which he had the kindness to exhibit at the December meeting.

Though the impression of darkness on the senses was that of something darker than an ordinary night, yet it was not, after all,

* Dr. Robinson gave a signal at the time first noted, and a second signal about 5ˢ later, which was not noted at the moment when given.

‡ See *Mem. Royal Ast. Soc.*, vol. xv. pp. 11, 13.

‡ It is clear that a faint object might thus be lost by one observer while visible to the other, and if dark glasses were used, incautiously, this might still more *easily happen.*

so very intense. Small print could be read, and the marks of a pencil in sketching seen.

The colours in the sky somewhat resembled those which may at times be seen in stormy weather on an autumnal evening, half an hour after sunset.

Christiania.

Latitude, 59° 54′ 5″ N.; Longitude, $0^h\ 42^m\ 53^s.9$ E., *Naut. Alm.*

Observations by Mr. Dunkin.

Mr. Dunkin, one of the assistants at the Royal Observatory, was, at Mr. Airy's request, directed by the Lords Commissioners to observe the eclipse. The station of Christiania was chosen by Mr. Airy as being on the west of the central passage, he himself observing that phase at Göttenburg. The telescope used by Mr. Dunkin is of $3\frac{1}{2}$ inches aperture and about 3 feet focal length, power 38, mounted on a firm tripod stand with steadying-rods. A chronometer by Dent, belonging to the observatory of Christiania, was employed for the time. There were two parallel wires in the eye-piece at 1′ distance. These wires were placed horizontally during the eclipse. The place of observation was in Mr. Crowe's garden, not far from the observatory, and was pretty open except to the north.

First External Contact, $2^h\ 41^m\ 48^s$, by Chronometer.*

Ten minutes before totality the darkness was becoming evident; at five minutes before totality Mr. Dunkin took off the dark glass, as the sun's light was faint enough to be borne without fatigue.

As the totality approached, no mountains were seen on the moon's limb, nor was any part of her limb visible *beyond* the sun.

"About fifteen seconds before the beginning of total darkness, the narrow line of the sun broke up into numerous small particles or beads of light. They were of different sizes, some being merely points, while others appeared more elongated; their appearance was of intense brilliancy, and the only thing they can be compared with is a necklace of diamonds. These beads were perfectly steady; their only change being their gradual disappearance as the total obscuration of the sun approached. The time noted for the beginning of total darkness was when the last spot of light was lost."

	h m s	
Beginning of Totality	3 44 49.5	by Chronometer.
End	3 47 24.0	——

Little appearance of the corona was seen, and no trace whatever of polarization: green was as bright as any other colour.

"Twenty seconds after the totality had commenced, a small cloud quite obscured the sun for a short time. When this had passed over, the red prominences were sought for. Of these, three were seen. The first was at an angle of 70° from the vertex

* The chronometer was $1^m\ 58^s.2$ slow on Christiania mean time.

towards the west; the second was at an angle of 100°; and the third at an angle of 145°. The last-mentioned was most curiously formed, having something of a horned shape; it was curved in the direction of the lower part of the field. Its height was about 1′ 30″, the breadth at the base 30″. It had a most remarkable appearance, and it was carefully watched to see if any change took place in its size (see figure 15). My eye was intently fixed upon it for about a minute of time, and during that interval, not the slightest change took place in its form. Its colour was pink, or rose colour, but the shade was not very deep. It seemed to me at the time, from the excessive steadiness of this prominence, and from the fact that I had zealously watched it for so long an interval without its undergoing any change, that this object had some connexion with the moon. However, as my observations have been all made under rather difficult circumstances, it is possible I may be deceived. With the doubly refracting prism, I could not perceive any difference in the brightness of the images of this prominence. The other two prominences were precisely similar to each other in size, their height being about 40″ and their breadth at the base 30″, and tapering to a point at the apex; these also remained perfectly stationary during the last minute of total darkness. As soon as the first ray of light from the sun appeared, they all disappeared instantaneously; I could not perceive the slightest trace of them after the formation of the beads on the reappearance of the sun. This second display of Baily's beads was again seen in all its beauty."

There was no distortion of the limbs of sun or moon. Clouds covered all up soon after the reappearance of the sun.

The darkness during the totality was very great, far beyond what was anticipated. The title-page of the "Suggestions" was read with difficulty at a distance of 10 or 12 inches, yet the outlines of mountains, at least 15 miles off, were faintly visible.

Lieut. Krag, who had undertaken to read the chronometer, was unfortunately called off upon duty, and Mr. Bennett, a student in the university, undertook the office without the necessary preparation. It is, therefore, not impossible that some error may have crept in. The wind was so high that Mr. Dunkin could not hear the beats.

Mr. Dunkin made a careful series of comparisons of the black bulb and free thermometer, but the results are rendered a little irregular by clouds.

Observations by Mr. Snow at the Observatory.

The telescope was a refractor by Dollond, 45 inches focal length, 2¾ aperture, power 35, mounted on a pillar and claw-stand with an adjustable equatoreal block set to the latitude of the place; the whole supported on a solid stone pillar in the garden of the observatory.

First External Contact $2^{h}\ 43^{m}\ 38^{s}$ Christiania M.T.*

* The observations were made with a good pocket watch, and this was compared *before* and *after* the eclipse with the Christiania transit clock.

The limb of the sun seemed to Mr. Snow rather better defined than the limb of the moon, though no lunar mountains were made out with any certainty.

"When the totality approached, the disappearance of the sun began to take place by the breaking up of the extremities of the horns into detached morsels of light, scarcely to be called bead-like, as they were not round nor quite steady, but slightly waving and undulating towards the points of the horns."

Beginning of Totality	3^{h}	46^{m}	53^{s}	Christiania M.T.
End — —	3	49	28	— —

"The corona was visible through a pretty thick cloud. It appeared not to be uniformly disposed, but in irregularly radiating bundles or masses." At the same time, four very bright, unequal, and not well-defined prominences, made their appearance: one shaped like a horn turned downward at about 125° from the vertex towards the west" (this was seen by all the observers, figure 14 like Mr. Snow's sketch); another at 70° west from the vertex; a third at 40° west from the vertex; and a fourth at 30° east from the same point.* The first-mentioned prominence was considerably larger than the others, but all were pretty equal in intrinsic brightness. "There was that about the large prominence which made me suspect that if I had seen it in a clear sky, it would have been filamentous at the extremity." The fourth prominence was marked on the paper as having two summits, but the recollection of it was less perfect than of the rest.

"The phenomena of the total disappearance were viewed through a pale blue eye-shade, which threw a grey tint over the whole." Mr. Snow remarks the similarity of position between the "horn" and a spot going off, and also between a pretty large spot, coming on, and the fourth prominence, which he believes he saw. "When the total darkness took place, it was not easy to decipher the figures of a watch held in the hand, and yet the distant hills were very visible."

RINGERIGEL, not far from CHRISTIANIA.

Observations by Lieut. Krag.

Lieut. Krag had intended to assist Mr. Dunkin, but was called away by his military duties. Having provided himself with a telescope and dark glasses, he found the opportunity to place himself at a station which commanded an extensive view of nearly 40 miles round.

In the early part of the eclipse, there was a great deal of interruption from clouds, but when the phase was of 11 digits, the sky became pretty clear, and kept so. Lieut. Krag, "on the approach of total darkness, clearly saw the shadow travelling across the country, and gradually increasing until at its height." During the

* These angles, when not specified by the authors, are *guessed*, from their sketches: they here refer to the position as seen by the naked eye.

totality, "the observations with the telescope were continued, and the reflexion from the earth was so powerful that the moon appeared almost the same as when seen by daylight at the same time with the sun."

"The moon's edge was surrounded by a perfect shining white border, the corona; and outside this, a narrow light violet stripe was observed."

It was not so dark as was anticipated. Lieut. Krag was able to read a book and distinguish, though faintly, the outlines of distant mountains.

Two flame-shaped prominences were seen on the edge of the moon with the telescope during the totality. The colour was a little redder than the light of the cotton taper with spirits used for lighting gas-lamps. These were not visible to the naked eye.

On the right, the horizon was lighted by the sun's returning beams and gradually became brighter and brighter. This was probably owing to the reflexion from clouds. While the right was thus illuminated, the left at the distance of 14 miles lay for a short time covered in shadow.

The wind fell a little before the totality, and rose very soon after.

The barometer was not affected; the thermometer fell 4°, but rose after.

DRÖBAK, about 19 miles S. by W. of CHRISTIANIA.

Latitude, 59° 40′ N.; Longitude, $0^h\,42^m\,30^s$ E. (by Map).

Observations by Capt. Biddulph, R.A.

This station had a very extensive horizon, and Capt. Biddulph attended principally to the picturesque effect of the eclipse. During the whole of the phenomenon the sun was obscured by so much cloud that a dark glass was occasionally unnecessary. Up to the time when the sun was three quarters covered, the light was not strikingly diminished, but a dull grey colour was cast over the landscape. As it became apparent that the sky would not allow of an observation of the totality, Capt. Biddulph laid his telescope aside, and looked for the effects of the coming shadow. "It was best appreciated by the sensation of darkness coming over one as a thick dark atmosphere, spreading itself over sky and land to the N.W., and more distinctly on the clouded sky overhead. At last the light was extinguished like a candle, the red roof of a house (which had been particularly noticed) was gone, and the horizon no longer visible. On looking up, the last bright ray of the sun had been covered, and only a faint trace of the corona could be seen through the mist. The rapidity of the motion of the shadow produced a feeling that something material was sweeping over the earth at a speed perfectly frightful. I involuntarily listened for the rushing sound of a mighty wind."

The time the sun was covered was about $3\frac{1}{2}$ minutes. The light was of a deep blue purple. In a group of blue and yellow

flowers and red strawberries, the blue was reflected, the red and yellow were not, yet the crimson purple blossoms of the clover were distinguishable.

Capt. Biddulph estimated the darkness to be more intense than that of the midnight preceding.

FYLDPAA, 40 miles S.S.W. of CHRISTIANIA, 4 miles W. of TONSBURGH.

Latitude, 59° 20′ N.; Longitude, $0^h\,41^m\,20^s$ E. (by Map).

Mr. Jackson and Mr. King observed at Fyldpaa, Mr. Jackson had a small hand telescope, Mr. King an astronomical telescope with a power of 40.

No appearance of the *beads* was seen at the totality; but one speck of light seemed to hang on the moon's disc, like a star previous to occultation.

After the totality had commenced, Mr. Jackson saw three red prominences. One at about 70° from the vertex to the west; another at 110° to the west (this is the hook-formed prominence seen by everybody); and a third at 140° to the west. On a second view, a little before the sun reappeared, a fourth prominence showed itself at about 45° from the vertex towards the west, and the other prominences, especially the hook-shaped one, were elongated. In Mr. Jackson's drawing (see fig. 14) it has the curvature gradual and the end is taper like a horn. Immediately afterwards, a pale red tinge passed over the lower edges of the moon, followed by a mingled light of pale colours, when, in an instant, the sun shone forth, and the red prominences disappeared. The beads were seen in the larger telescope by Mr. King, but not by Mr. Jackson with the smaller.

JUNE, *near* SARPSBORG.

Latitude, 59° 14′ N.; Long. $44^m\,18^s$ E. *approx.*

Observations by Mr. Gray.

The station was an eminence near the church of June. The telescope was 3⅞ inches aperture, focal length 53 inches, and power 60. At the commencement the sky was covered, but when the moon was half advanced on the sun's disk, the irregularities on her limb were well defined. The observations of totality were not very satisfactorily noted, as the attention of the observer was partially withdrawn from the telescope to other observations. The duration was about $3^m\,10^s$

Just before totality the sun's limb broke into numerous irregular beads of light.

The corona, seen by the naked eye, appeared a ring of white light in the clouds, its breadth being about equal the moon's radius; gradually fading away, without radiations.

Mr. Gray saw four red prominences, the position of which he estimates to be as follows:—

1, on the West side at	15° South	of the parallel	of declination.
2, on the East	5° North	—	—
3, on the West	30° North	—	—
4, on the West	60° North	—	—

But the parallel of declination is only roughly estimated.

No. 1 at first appeared about $1'\frac{1}{4}$ high and half the breadth, taper at the top; but as the eclipse advanced, it had apparently shot out as a gas-jet when fully turned on, and with a portion curved to the south; in this state it is fairly like Mr. Airy's sketch (see fig. 13). It was then fully $1'\frac{3}{4}$ high. No. 2 was broader and fainter than 1, and its north end highest. The other two, about $1'$ high, were nearly square, and tuft-like, about $50''$ high, uneven in their outline, and indistinct at the base.

During the totality, the light seemed about the same as on the 2d August, in latitude 59° at $1\frac{1}{2}$ hours after sunset. The seconds on the chronometer were easily read; and the outline of the hills was distinctly visible.

The reappearance was preceded by a red light on the moon's limb, and the sun broke out at once in several beads.

Fredrichsvaarn.

Latitude, 59° N.; Longitude, $0^h\ 40^m$ E. (by Map).

Observed by Mr. R. Stephenson.

The telescope employed was equatoreally mounted, and had an aperture of $3\frac{3}{4}$ inches, power 35: it inverted. Capt. Andrews noted the time by his chronometer.

	h m s	
First External Contact	1 51 30	Time by Chronometer.
Beginning of Totality	2 54 17	— —

The crescent of the sun, before disappearing, was gradually reduced to a fine thread of light, which broke up into fragments. In a second or two a rose-coloured flame shot out from the upper part of the moon's left limb, which in form resembled a sickle with the cutting edge uppermost (see fig. 14). This increased in size very rapidly, and then, other two rose-coloured prominences, one on the right and the other on the left, started out, neither of them so peculiar in shape, but evidently of the same character. These red prominences began as red specks, which almost immediately became summits by the extension below into bases.

The prominence which was sickle-shaped seemed illuminated at the back, while the edge seemed in shadow. Its estimated altitude was one-twentieth of the moon's diameter.

	h m s	
End of the Totality	2 57 47	Time by Chronometer.

"The reappearance of the sun was remarkably instantaneous, presenting, not a fine line of light, as it had done in disappearing, but a series of spots of silver light, which suggested the idea of

globules of mercury rushing among each other along the edge of the moon." In two seconds the crescent formed and the rosy prominences disappeared.

The corona was a little irregular, and as if composed of separate diverging rays. The darkness was great, but a man could be distinguished at 70 or 80 yards; and it was light enough to see the sketch which was made of the moon and of the red appendages.

A thermometer on the grass fell from 70° to 58°.

The times are given according to a chronometer, which, from observations taken several days before, Capt. Andrews inferred to be $10^{m}\ 40^{s}$ slow on Greenwich M.T. Capt. Andrews took angular distances between the cusps during the advance of the moon on the sun.

Mr. Stephenson's sketch of the eclipse is not found with his paper, only a pencil outline of the sickle-shaped prominence.

TROLLHÄTTAN FALLS.

Latitude, 58° 17′ 30″ N.; Longitude, $0^{h}\ 49^{m}\ 8^{s}$ E.

This position is near the celebrated Trollhättan Falls, about 40 miles north of Göttenburg. The observers, Messrs. Lassell, Williams, and Stanistreet, stationed themselves in different apartments of the hotel, the weather out-of-doors being very stormy and unpropitious.

Observations by Mr. Lassell.

Mr. Lassell used a telescope by Merz, of Munich, of 2·55 inches aperture, and 32·5 inches focal length, mounted on a rude but effective equatoreal stand. The eye-piece was a negative or inverting one, power 35. The sun became clear before the first contact, and its heat was so great that the dark glasses were broken with startling rapidity. The aperture was then limited to 2 inches, and the slide of dark glasses was heated over a candle until it was too hot to be touched. This succeeded, and the telescope was kept pointed to the sun, so that the dark glass could not get cool.

Two spots were noted. The estimated position of the preceding spot (a well-defined spot with three or four small dots near it), referred to a parallel of declination, was 288°, and of the following spot 90°, measuring from the north round by the east. The first contact was expected at an angle of position = 284°, and as Mr. Lassell kept his eye fixed on that point, and the sky was clear, he considers the observation very exact.

	h m s		
First Contact	2 10 32	by the Watch;	exact.
Spot Touched	2 12 36	——	not good.

The southern limb of the moon had four or five well-defined summits, one more prominent and insulated than the others. "Some were more elevated, in proportion to their bases, than I remember to have seen on the moon's limb projected on the sky.

As the moon advanced, there did not appear to be any obvious difference of brightness in different parts of the sun. The cusps of the sun were in no degree distorted, even when not more than 50° or 60° of the sun's circumference apart."

"As the totality approached, which it seemed to do with amazing and fearful rapidity after the cusps embraced about 50°, I looked carefully for 'BAILY's *beads*,' as well as for any *drawing out* or osculation of the limbs about to touch, *but I could perceive none*. It is true the thin line of light broke up into pieces immediately before extinction; but I remarked that it was precisely where the remarkable prominences were situated that these 'beads' appeared, and I could perceive no phenomena in them which the projection of these mountains would not explain.

	h m s		
Total Obscuration	3 13 6·8	Watch	Instantaneous and
Reappearance ...	3 16 26·0	—	well observed.

"Clouds came on and the end of the eclipse could not be observed.

"The watch at the time of the eclipse was fast on Greenwich 5^m 57^s, and slow on the place 43^m 11^s. This error is deduced from altitudes of the sun on the 29th and 30th, in addition to others taken on the 27th. The result is checked by two other good watches, and can scarcely be wrong more than 1^s or 2^s.

"At 3^h 4^m the landscape became strikingly pale, the shadow of the house and of other objects contrasted but feebly with the sunshine." During the totality, "on withdrawing my eye from the telescope, I could neither see the seconds hand of my watch nor the paper sufficiently to write the time down, but had recourse to a candle. Probably the suddenness of the gloom, not giving time for the expansion of the pupil of the eye, increased the sensation of apparent darkness, as I was obliged to repair close to the candle for the requisite light."

On looking at the moon with the naked eye, she appeared neither very round nor very smooth, but as if rudely cut out with a jagged outline. "The corona itself was perfectly concentric and radiating, some of the rays appearing *longer* than the rest, but the irregularity was not great. I was greatly surprised at the light of the corona, to which I should be almost inclined to apply the term brilliant, and I think it was sufficient to account for the light on the sky and landscape. Vaguely, I think the corona gave nearly as much light as the full moon." There was some haze, which obscured *Mercury*, but *Venus* was seen. But for the haze, probably the first magnitude stars would have been visible, as the darkness seemed greater than midnight had done at Christiania.

As soon as the heat from the sun had become sufficiently reduced, Mr. Lassell gave his telescope its full aperture, and applied a power of 43; the totality, and the observations which succeeded totality were observed with the whole of the object-glass. *After noting* the general appearances as presented to the naked

eye, Mr. Lassell looked for the "red flames" which he had heard described as but faint phenomena. "In the middle of the field was the body of the moon, rendered visible enough by the light of the corona, attended by apparent projections behind her" (a conical-shaped mass at about 90°; a sort of horn at 270° curved upwards,* with a detached mass just above the point; and two other conical masses at 290° and 315°). "The prominences were of a most brilliant lake colour, a splendid pink, quite defined and hard. They appeared to me not quite quiescent, but the moon by her movement might cause an idea of motion. They were evidently belonging to the sun; for, especially on the western side, I observed that the moon passed over them, leaving them behind, and revealing successive portions as she advanced. I observed only the summit of *one* on the eastern side, though my friends in the adjoining rooms had seen two. The moon had covered one, and, probably, three-fourths of the other, while I was engaged in registering the time and making my observations with the naked eye. The principal flame (that which is figured in the plate No. 8), as I judged, was a few degrees south of the place where the cluster of spots was situated, and the flame on the eastern limb corresponded almost exactly with the place of the eastern spot. As, however, some prominences appeared on parts of the sun's limb not traversed usually by spots, the connexion between the two is not made out." By a rude estimation Mr. Lassell thinks that the principal prominence may have been about $2'\frac{1}{2}$ in length.

Observations by Mr. Williams.

Mr. Williams observed with a telescope of $2\frac{3}{4}$ inches aperture, and 42 inches focus, fitted with a micrometer. He lost several dark glasses, which he had been the habit of using for the last five years, by the intense heat of the sun.

First Contact $2^{h}\ 53^{m}\ 48^{s}$ Mean Time at Place.

"The light began to wane perceptibly when about nine-tenths of the sun's disc was covered. With a power of 110 the mountains on the moon's limb were visibly defined upon the sun's disc; their position was chiefly south of the moon's centre and towards the southern cusp. As totality approached, the sun's uneclipsed limb presented the appearance of a most brilliant golden thread, of a segmental form; this instantaneously broke up into beads and strings of light, presenting the phenomenon known by the name of 'BAILY's *beads*.' These were observed on the southern cusp *only*, and in positions corresponding with those of the mountains seen on the moon's limb. The phenomenon seems clearly accounted for by the sun's rays shining through the valleys between the mountains in the moon."

The duration of the "beads" might be four or five seconds; when they had disappeared, the corona and red prominences became

* In an inverting telescope.

visible. The corona shone with a feeble light, perhaps equal to one-third that of the full moon. It was divided by radial lines, and presented the appearance of luminous brushes shot from behind the moon. It extended about one-third of the moon's diameter from its edge.

Mr. Williams saw "two conical red prominences (at about 90° and 100°) on the following or east limb, subtending about 38″ by the micrometer. As the moon advanced, she speedily covered these. On the preceding, or western limb, three prominences were visible." One (at 325°), like an inverted cone, the apex towards the sun: it resembled fire violently shot forth from an orifice. The appearance of the second (about 280°) (see fig. 9) was wonderful beyond description. After ascending vertically, with respect to the sun, a vast height, it bent off to the south nearly at right angles, extending itself to almost an equal distance in that direction." As the moon progressed and left it behind, this prominence increased in size and brilliancy; it resembled fire, the edges were not well defined, especially towards the extremity, and it seemed surrounded by vapour, which was most perceptible towards the extremity. By the micrometer its height was found to be 1′ 41″. Another prominence was seen (about 270°), which also resembled fire; it was smaller but better defined than the two just described.

During the totality *Venus* was seen with the naked eye; but other planets and stars were probably obscured by a thin film of clouds. The largest red prominence was also visible by the unaided eye. The corona was not so well marked as through the telescope. Both the corona and the red prominences disappeared at the first rays from the sun. Clouds soon afterwards collected, and the last contact was completely hidden.

Next day a spot made its appearance on the following limb, just where the more southerly of the two red mountains had appeared. The coincidence of these two spots with the two prominences seen on the following limb, and of the large and remarkable prominence on the preceding limb with the large spot at that place, seems to deserve attention.

Observations by Mr. Stanistreet.

Mr. Stanistreet used a telescope of $2\frac{1}{4}$ inches aperture and $3\frac{1}{2}$ feet focus, by Dollond, with a power of 80.

First Contact $2^{h}\ 53^{m}\ 45^{s}$ Local Mean Time.

During the progress of the eclipse, several depressions and eminences were observed on the advancing limb of the moon: one mountain was pre-eminent. The spots on the sun were observed as already described. At $3^{h}\ 45^{s}$ the day became perceptibly darker, and at $3^{h}\ 55^{m}\ 50^{s}$ local mean time the moon came in contact with the eastern spot. "While noting the time I observed the light diminish with awful rapidity, and it seemed as if a great pall of *shadow* was descending upon the earth." Mr. Stanistreet's ac-

count of the phenomena of "BAILY's *beads*" corresponds precisely with that of his companions; "no beads were observed at that portion of the crescent where the moon's limb was free from any sensible projection."

The corona was formed at the instant of total obscuration, and several bright pink prominences were immediately observed on both sides of the moon. The colour was that seen on the edge of a sunlit cloud at sunset, being of a bright crimson, or, rather, rose hue.

Mr. Stanistreet saw and noted a red prominence on the following limb (at about 85° or 90°), and thinks he remembers another (at about 95° or 100°), but cannot assert this positively. On the preceding limb he saw three, which were apparently in contact with the moon's limb. These are nearly in the places assigned to them by Mr. Williams, but above the remarkable prominence, he saw "a small cloud-like mass apparently detached from the moon." The remarkable prominence he describes "as curved, like a man's arm. It appeared to alter its shape rapidly, unfolding more and more of the curve as the phase proceeded." (See fig. 2). Just previous to the sun's reappearance the height was measured by the micrometer, and found $= 1' \, 42''$.

Mr. Stanistreet states, that the darkness was so great that, "having attempted during the totality to mark the places of the prominences upon a card on which a circle of 4 inches was drawn strongly with Indian ink, the pencil-marks were afterwards found at some distance from the circle, and utterly useless for the purpose intended."

That the motion of the moon was relative to the prominences, uncovering on one side and covering on the other, Mr. Stanistreet agrees in opinion with Messrs. Lassell and Williams. He could only see *Venus*. He calls attention, with Mr. Williams, to the coincidence of the prominences and the spots.

LILLA EDET, on the Göta River.*

Latitude, 58° 7′ N.; Longitude, $0^h \, 48^m \, 32^s$ E.

Observations by Mr. Carrington.

The telescope employed in these observations was one by Mr. Simms. It had an aperture of $3\frac{1}{2}$ inches, and focal length of about 4 feet. The power was about 70, and a slide, containing the coloured glasses, moved in a groove at the end of the eye-piece.

Before the eclipse commenced, the spots were noted and referred to the vertical. The shade, which proved most convenient, gave the sun a pale green colour. The moon's preceding limb, projected on the sun, was very rugged. The cusps seen through the telescope, were always perfectly sharp and well formed, with

* Mr. Carrington was in company with Mr. G. P. Bond, but they separated on the day of observation to improve the chance of success. Mr. Bond's account is expected, but not yet received, as he was unable to draw it up before his departure for the United States. Mr. Carrington's account is printed for private distribution.

one exception at about $3^h 45^m$ local mean time, when there was, for about a minute, a manifest indent in the moon's outline, a little within the southern cusp.

There was no trace observed of the moon beyond the sun at any time during the eclipse. The gloom came on insensibly at first, but latterly very rapidly; it was murky and unusual in kind.

At the disappearance of the sun, "for a short time, the portion of light remaining appeared of uniform width, with sharp cusps; without any notice it flew into numerous little lines, these lines contracted into dots, some again breaking up, the dots contracted and the sun was gone. . . At the time, the ruggedness of the moon's limb seemed to account for the breaking up of the light; but a recollection of the great regularity of size and arrangement of the dots, which is strongly impressed upon my memory, goes greatly against such an opinion."

A rapid glance at the sun, while taking off the slide of dark glasses, showed the corona, "which was a pure white, brightest next the moon, and insensible at a distance of one-fifth of her diameter: it blended into the sky in one shading off." A star was hastily seen, a very palpable object, which might be *Mercury* or *Regulus*. Immediately afterwards a small pink prominence was seen at an angle of about 100° from the vertex towards the east; it was of the form of a haycock, and rapidly diminished: in 10^s it was gone. Directing the telescope all round the moon, three other prominences were seen; one, also of a haycock form, at about 45° from the upper limb towards the west, and two others at 120° and 130° in the same direction. The colour was pink, tinged with white. The appearance of the two last-mentioned was so remarkable (see fig. 12), that Mr. Carrington confined his attention to them. They evidently increased in size as the moon advanced, and the change is fully accounted for by the successive laying bare of their bases as the moon gradually uncovered them. The appearance of the larger was like that "of a mighty flame bursting through the roof of a house and blown by a strong wind." But though the form was highly suggestive of motion, no change of outline was perceived. The upper portion was curved downwards, almost at right angles to the base. The neighbouring prominence was simpler in form, and, perhaps, a little forked towards the other. "I was greatly astonished by the appearance of five or six *bows of light*, which seemed to connect the summits of these prominences; I noted the colour of the bows as yellow. They maintained their relative position till all vanished. The highest bow was estimated to be 2′ distant from the moon's limb, and the highest part of the remarkable prominence to be 1′·5, shortly before the end of the totality." (The bows are marked in black in fig. 12).

The thermometer was shaded from the direct rays of the sun by four thicknesses of sail-cloth. It fell from 66°·5 at $3^h 28^m$ local mean time to 58° at $4^h 22^m$, *i. e.* about 21^m after the reappearance of the sun. Haze came on very rapidly after the reappearance, and increased so much that the end of the eclipse could not be observed.

The degree of darkness during the totality was less than expected. Mr. Carrington could read his watch, which lay at his feet, with a glance; and the title of the "Suggestions," which was hung up at a distance of three yards, was legible enough.

In watching the rose-coloured prominences, Mr. Carrington tried both eyes, and found that they each gave precisely the same appearance.

Observations by M. S. Mygind, Overseer of the Canal at Lilla Edet.

"The darkness during the total eclipse appeared to me not greater than what is usual on a summer's evening in this part of the country in the beginning of July at 11 P.M.

"Directly after the commencement of the totality, a small flame was seen, somewhat crooked, and, as it appeared to me, bending towards west and south, or perhaps south-west—it was of a reddish colour; a smaller one, rather of a round shape, was seen close to it, below." The telescope is non-inverting. M. Mygind's sketch agrees very well with Mr. Carrington's, only the curve is more gradual and like a horn. (See fig. 10.)

Observations by M. L. Svangren.

	Thermometer. Sun.	Shade.	
Before Commencement	$+23^\circ$	$+17^\circ$	Centigrade.
End of Totality.........	$+18$	$+13$	——

The observations are valuable for their account of the effect upon objects animate and inanimate. Birds seemed terrified, cows and dogs fed as usual. The night violet had its scent greatly increased.

Observations by Dr. J. Boustedt.

"When the eclipse became total there appeared round the moon a bright white ring" (the corona), "which was even, except that it seemed somewhat rugged and more extended towards the left of its upper part."

On the left of the vertex were two red prominences, beyond the limb of the moon, and connected with it; these may be considered at 20° and 60° from the vertex, reckoning towards the east or left. Prominences were seen on the right, in the places noted by Mr. Carrington. Dr. Boustedt's sketch (see fig. 3) is straighter and more gradually curved than Mr. Carrington's. "The upper part of this hook-formed protuberance appeared blue, the lower part rose-red, and fainter in colour at its lower edge. Below this hook-shaped prominence a smaller red spot, *not connected with the moon's limb*, was seen, surrounded with the light of the corona." Another prominence was seen at about 160° from the vertex, measuring towards the west. The prominences, with the exception of the hook-shaped

one and the detached spot, projected from the moon at right angles, and were of a rounded shape.

	Thermometer. Sun.	Shade.	
Beginning of Eclipse	+ 25°	+ 19°	Centigrade.
Totality	+ 17	+ 15·5	——

GÖTEBORG or GÖTTENBURG, School of Navigation.

Latitude, 57° 42′ 6″·2 N.; Longitude, $0^h\ 47^m\ 50^s$·6 E.

Observations by Lieut. Pettersson, Director of the School.

The telescope was made by Pistor and Martins, and had an aperture of about 1·9 inches. The commencement was observed with a power of 68, the rest of the eclipse with a power of 40, which gave a field of 1° 8′.

Lieut. Pettersson noted the spots before the eclipse.

	h	m	s	
First External Contact	2	53	3·9	Göteborg M.T.

This determination is considered to be good.

The advancing limb of the moon was strongly serrated.

At about 15^s before the totality, Lieut. Pettersson saw, through the red glass which he used as a shade, the continuation of the moon's disc beyond the body of the sun, both above and below the luminous crescent. BAILY's *beads* were carefully looked for, but not seen.

	h	m	s	
Beginning of Totality	3	55	52·2*	Göteborg M.T.

The disc of the moon was very dark (grey-brown). The corona was composed of rays proceeding from the centre of the double disc which gradually faded away. "Along the part of the moon where the sun disappeared, there remained for some seconds a light of a rose colour, which projected itself on the corona" Lieut. Pettersson saw on the same eastern limb "two *white* flames very near each other. The brighter and smaller, at about 80° from the vertex, was like a short horn turned downwards; the other, much larger and fainter, like a sharpish equilateral triangle, and just above the former." "Other objects on the western limb now drew all my attention. Two prominences of a bright rose colour gave me the not on of a gaseous substance inflamed and projecting outwards. The smaller of these soon seemed to leave the moon's edge, and to float freely in the light of the corona. The other, which was curved towards the former, and much inclined to the edge of the moon, increased with the moon's advance, and finally attained a length which I estimated at 2′. I observed no change that was not due to the motion of the moon." (The large prominence is about 100° from the vertex, see fig. 5).

"About 5^s before the reappearance, I saw along the edge of the moon, just where I expected the sun, a red fringe of rose colour,

* *After* correcting an error in the assistant's note of time.

on which the remarkable prominence just mentioned seemed to rest, and of which it seemed a part."

	h	m	s	
End of Totality........	3	59	8·2	Göteborg M.T.
Last External Contact	4	58	2·6	— —

but this was observed with great difficulty on account of clouds.

During the totality Lieut. Pettersson was able to make a sketch of the remarkable prominence without the assistance of a light. He calls attention to the near coincidence of the prominences and the spots.

Near GÖTTENBURG.

Latitude, 57° 42′ 10″·6 N.; Longitude, $0^h\,48^m\,0^s{\cdot}4$*

Observations by the Astronomer Royal.

Among several insulated granite hills near Göttenburg, Mr. Airy selected one called *Hvaläs* or the *Whaleridge*, about two or three miles from the town, and rugged at the top, which afforded shelter from the wind.

Mr. Airy was provided with a 46-inch telescope of nearly 3¾ inches aperture; a good telescope which shows the mottled appearance of the sun well. The mounting is equatoreal and solid. There were four eye-pieces, and a graduated dark glass consisting of two wedges of red and green glass, separated by a wedge of colourless glass with the angle the contrary way. This combination exhibits the sun's disc with a yellow tinge. Lieut. Pettersson supplied Mr. Airy with a good box chronometer beating half seconds.

Two spots were seen on the sun, one macula near the eastern limb of considerable size, and close upon the western limb there was a chain of small maculæ.

	Time by Watch.†			
	h	m	s	
First Exterior Contact	2	4	2	Probably 4^s or 5^s late.

During the progress of the eclipse, the extremely mountainous outline of the moon's disc was remarked. About a quarter of an hour before totality, *Venus* shone with much brilliancy. At $2^h\,52^m$ by watch, the flame of a candle was visible at 2° angular distance from the sun. A power of 34 was now applied to the telescope. "With this I saw the mountains of the moon perfectly well. I watched carefully the approach of the moon's limb (a phenomenon which my graduated dark glass enabled me to see in great perfection). I saw both limbs perfectly well defined to the last, and saw the line becoming narrower, and the cusps becoming sharper, without any distortion or prolongation of the limbs. I saw the moon's serrated limb advance up to the sun's, and saw the light of the sun glim-

* Deduced by Lieut. Pettersson from a triangulation connecting the station with the Navigation School at Göttenburg.

† Chronometer *slow* on Göttenburg M.T. $0^h\,48^m\,6^s{\cdot}55$.

mering through the hollows between the mountain-peaks, and saw these glimmering spots extinguished, one after another, in extremely rapid succession, but without any of the appearances which Mr. Baily has described. I saw the sun covered, and gave the signal for time, which was taken from the chronometer at $3^h\ 7^m\ 50^s$; and, in spite of the difficulty of reading, to which I shall allude, I have no doubt that this register is correct; as my excellent assistant, Mr. Hasselgren, had kept his eye carefully fixed on the chronometer, and was listening to its beats."

Slipping off the dark glass the corona was immediately visible; in Mr. Airy's drawing, the rays, or rather bundles of rays, are very strongly marked. The corona was far broader than that which Mr. Airy saw in 1842; its breadth was little less than the moon's diameter, the structure radiated, and it terminated, though very indefinitely, in a way which reminded him of the ornament placed round a mariner's compass. The colour was white, like that of *Venus*. No flickering was sensible, nor any annularity of structure. The darkness struck Mr. Airy as more profound than in 1842; the chronometer could not be read without a candle, nor could pencil-marks be seen until after a very near approach to the lantern.

The red prominences were very remarkable. Mr. Airy has given three drawings of their appearances. At the first view, there was a conical prominence seen at about 80° from the vertex to the east, and one, a very odd-looking one, about 90° to the west. This is shaped like a *bomerang* with the extremity downwards. A little below the bomerang was a small protuberance adhering to the sun, and yet a little farther below, a detached cloud or balloon, nearly round, and separated from the moon's limb by the corona. (See fig. 1.)

In the second view, the eastern spot had disappeared, the moon having overlapped it, and the two on the west, which touched the moon, were lengthened, the moon evidently having uncovered more of their bases: the detached portion was farther removed from the moon's limb. And now a conical prominence came into sight, at about 60° to the west, measured from the vertex.

In the third view, just before the sun reappeared, all these objects were still further lengthened, from the moon's motion as before mentioned; and a *sierra*, or range of serrated eminences, came into view, extending from 135° to 165°, measured from the vertex towards the west, nearly where the sun reappeared. This *sierra* is seen in the drawing representing Mr. Dawes' sketch, which contains a second *sierra*, almost in prolongation of this.*

The colours of the prominences seemed to have varied somewhat, but to have been vivid in the oddly shaped one, and generally brighter on the edge. The *sierra* was a full colour, nearly scarlet.

* The angles are guessed from the sketches, which, as the sketches were made from hasty reminiscences, is near enough for the purpose of *illustration,—all that is intended in this* Notice.

End of Totality $3^{h}\ 11^{m}\ 6^{s}$ by the watch.

When the sun reappeared, Mr. Airy's eye was caught by a duskiness in the south-east, the eclipse shadow in the air travelling away in the direction of the shadow's path. This shadow remained in sight at least 6^{s}, and was far more conspicuous than was expected.

The sky became gradually thicker, and it was almost impossible to distinguish the sun's limb.

Last Contact $4^{h}\ 9^{m}\ 51^{s}$ by the chronometer; very uncertain.

the correction of the watch being as before $+0^{h}\ 48^{m}\ 6^{s}\cdot55$.

Time by Chron. h m	Thermometer in Shade. °
2 14	64·4 Fahr.
2 25	63·0
2 59	60·9
3 58	58·2
At the end.	61·0

From accounts given to Mr. Airy, he conceives that *Mercury* and *Regulus* were seen at Göttenburg.

Latitude, 57° 43′ 5″ N.; Longitude, $0^{h}\ 47^{m}\ 49^{s}\cdot1$ E.

Observations by Mr. W. Swan, and Mr. E. W. Lane.

Mr. Swan employed a good telescope of 2·1 inches aperture, and 31·5 inches focal length, magnifying power about 28. The dark glass was a coloured prism, achromatised by a colourless glass, which made the sun appear yellow with a slight tinge of green.

The times were taken by a box chronometer, lent by Lieut. Pettersson of the Navigation School, and rated by him on his own standard chronometer. Though there was a little thin cloud over the sun, the definition was remarkably good, until the totality was over. "During the progress of the eclipse, the cusps continued quite sharp until the sun was reduced to an extremely narrow crescent of 90° or less in extent, when they were sensibly rounded. This appearance became more and more decided, until at length the moon's limb was quickly joined to the sun by numerous thick lines which occupied nearly all the remaining crescent of the sun. The spaces between the lines were at first rudely rectangular, but gradually became rounded, so as to resemble a string of bright beads, after which they finally disappeared. The same phenomena were seen in a reverse order after the total phase, but the beads were less numerous than before."

Immediately after the disappearance of BAILY's *beads* the sun was viewed with the naked eye and the corona was seen fully formed. "The darkness at first seemed very great, owing to the contrast of *recent sunshine*, and Mr. Lane found a candle necessary

for reading the chronometer. . . On looking through the telescope, having removed the shade, the first object which attracted my attention was a remarkable hook-shaped red prominence at 110° 30′ to the west of the sun's vertex, and immediately afterwards I saw another red prominence, with a serrated top, resembling a chain of peaked mountains, at 132° 40′ west of the sun's vertex. The hook-shaped prominence was somewhat like Eddystone light-house, if you conceive the top beginning to fuse, and bent over like a rod of half-melted glass."

These prominences increased in height as the eclipse advanced, "evidently owing to the gradual disclosure by the moon of those parts which were nearest the sun." They were of a full rose tint, and were distinctly visible to the naked eye.

"The corona cast no sensible shadow. Seen in the telescope its colour was silvery white. It was distinctly radiated, and showed no trace of annular structure. Brilliant beams of light shone out in various directions to some distance beyond the general outline of the corona. A conoidal mass, with somewhat concave sides, and its base to the sun, was remarked at 28° 30′ from the vertex towards the east."

Observations of spots of the sun, and of the red prominences observed by Mr. Swan.

	Göttenburg M.T. h m	Angle from Sun's Vertex. ° ′
Group of Spots 1′ from Limb............	1 37	96 30 W.
Single Spot 1′ from Limb	1 40	62 0 E.
Hook-shaped Prominence	3 8	110 30 W.
Serrated..	3 8	132 40 W.
Brightest Rays of Corona	3 8	28 30 E.

Phases of the Eclipse.

	Göttenburg M.T. h m s	
First External Contact	2 53 4·4	about 2ˢ late
Beginning of Totality	3 55 52·6	
End............................	3 59 8·1	
Last External Contact	4 57 57·8	Probably too late

Meteorological Observations.

Göttenburg M.T. m s	Dry Thermometer. °	Wet Bulb. °
2 45	66 Fahr.	60 Fahr.
4 10	57	55
4 55	62·3	59·1

Mr. Swan made his observations in *position* with a micrometer of rudish construction, but sufficiently exact for his purpose. The tube carrying the eye-piece had two arms, in contrary directions, fixed upon it, each of which was furnished with a spring pointer. The tube through which this passed had upon it a disc of flat brass, covered with a disc of card. The card disc is immoveable, while the eye-tube with its pointers turns freely round. There are

three equidistant wires in the eye-piece, the two outer wires being just equal to the moon's diameter. When, therefore, these embrace the moon's disc, the middle wire passes through her centre. It is easy in this way to prick holes in the card corresponding to the direction of the wires; and if the centre wires are tangents to the moon, and the middle wire passes over any spot or prominence, the direction of the wires will correspond to the position of the spot, &c., referred to the moon's centre. Mr. Swan seems to have had a telescope with a horizontal and vertical motion, and he adjusted his zero by a level; all his measures refer to the sun's *vertex*. With an equatoreal the process would be much simpler.

Observations by Mr. John Adie,* at the Hotel *Götha Kellare.*

The telescope had an object-glass of 1·6 inches aperture, and 10·75 inches focus, with an erecting eye-piece, power 15: it was held in the hand, but steadied by a support.

"At 3^h 35^m Göttenburg M.T., the moon appeared to have a narrow sharp band, intensely black, round the whole portion of her disc seen projected on the sun; while, within this black band, a portion of the body of the moon appeared illuminated, and of a greyish white colour. At 3^h 40^m I saw distinctly a portion of the moon's edge beyond the part projected on the sun, and I estimated this to extend to about 8° round the moon's circumference from each point of the cusps."

The most remarkable of the rose-coloured prominences was that on the western limb about 100° from the sun's vertex. When first seen, it had the form of a half-crescent moon, with a rich rose colour at the edges, and fading into a more yellow hue towards the centre. Its estimated altitude was $1'\frac{1}{2}$ when first seen. A little south of this, and opposite the point of the crescent, there appeared an irregular mass of the same colour, perfectly detached from the crescent and from the body of the moon; it appeared suspended in space (see fig. 8). Two other rose-prominences were seen, one at 135° from the vertex to the west, and the other at 95° to the east, 2′ high, perhaps. As the moon advanced, the crescent-shaped prominence increased, till it was perhaps 3′ high. The eastern prominence diminished one-half. There was no relative change observed between the neighbouring rose-coloured prominences, nor any instability or wavering about their colour or intensity. They became visible at the disappearance of the beads, and were blotted out at the moment of their reappearance.

The corona was brightest near the sun, and extended about one-third of the moon's diameter; of a soft silvery white, with brighter coruscations shooting through it beyond the general light, which gave it a flickering appearance. Over a space of 30°, measuring from the sun's vertex to the east, these coruscations extended to about two-thirds of the moon's diameter, and this space was the

* **Taken from Mr. Adie's published account.**

brightest throughout. The moon's surface seemed to have a faint greyish light over it.

Mercury and *Venus* were visible, and *Jupiter* was said to be so. Bright stars were looked for, but the sky was too cloudy. The colour over the landscape was of a bluish-black livid hue. The amount of light during the greatest obscurity was estimated at about half moonlight. The hour and minute hands of the watch were visible, but not the seconds' hand, nor the minutes on the dial.

Observations by the Rev. Temple Chevallier.

The position taken by Mr. Chevallier was an elevated platform on the top of the *Götha Kellare* Hotel, about $2\frac{1}{2}$ miles N.W. of the hill where the Astronomer Royal was stationed. The telescope, by Ross, was one presented by the late Duke of Northumberland to the Durham Observatory, aperture 5 inches, focal length 7 feet 2 inches, power 180. This was mounted equatoreally on a temporary stand, and would have been sufficiently steady in a less exposed situation. The dark glass consisted of a wedge of red glass combined with colourless glass, in the manner recommended in the "Suggestions." A diaphragm, to limit the aperture, was used for the first half hour after the beginning. The first external contact was lost. At $2^h\ 55^m\ 7^s{\cdot}1$ Göttenburg M.T., the moon eclipsed the darkest part of a spot upon the north-western edge of the sun. Very marked prominences were observed upon the moon's edge, one of which was estimated by Mr. Chevallier to subtend an angle of 50″.

When the sun was two-thirds eclipsed, the light near the middle of the disc of the sun was estimated to exceed the light of his edge, in the proportion of 3 to 2.

Just before the totality commenced, the moon eclipsed a spot upon the N.E edge of the sun at $3^h\ 55^m\ 7^s{\cdot}9$ M.T. As the field of the telescope would only take in a portion of the sun, Mr. Chevallier directed his attention to the upper cusp. "The light was there less bright than elsewhere, and the whole cusp was more like a liquid than a solid. As the cusp became narrower, the light had a fluctuating motion, and seemed to fail by running along the sun's edge, trickling away like drops of quicksilver down a narrow groove, so as partially to interrupt the continuity of the rim of light; but not so as to form any fixed bounds of alternate light and darkness."

Beginning of Totality $3^h\ 56^m\ 54^s{\cdot}9$ Göttenburg M.T.

"To the naked eye, the moon appeared as a black spot surrounded by its luminous corona, the radius of which was about a sixth part greater than the radius of the moon." Mr. Chevallier saw *Venus*, but did not look for *Mercury*: *Mercury*, *Jupiter*, and *Regulus*, are said to have been seen at Göttenburg by others. "*The hills from 6 to* 10 miles distant were distinctly visible, and

during the whole obscuration, the figures on the face of the chronometer and pencil-writing could be read."

Mr. Chevallier then directed his attention to the opposite side of the moon, that from which the sun would emerge, and observed three bright prominences. "That which was the lowest was a pink protuberance, the base of which was about $\frac{1}{2}'$ wide, rising to a single peaked ridge about half the height of its base. The form of this changed but little. The two others (see fig. 11) above this were much higher and larger. Each rose from a narrow base, and with a waving outline, extending in the upper part into a long flag-like position, tinged at the edge with a delicate pink colour, brighter than the other parts. Their appearance was that of high clouds, brilliantly illuminated at sunset." Careful inspection showed "that the objects were certainly connected with the sun, for the separation of the edge of the moon from them, as she moved onwards, could be distinctly seen." The height of the largest, at about 1^m before the end of the eclipse, was estimated at $1' \, 12''$. "As the eclipse advanced, the light from behind the moon became like the brightest twilight, rising higher and higher above the moon's surface, and forming a brilliant red edge, until it was effaced by the reappearance of the dazzling white light of the sun."

The corona cast no shadow, and the shadow cast by a wax taper in a lantern was invisible, when the taper was 193 inches from the screen.

The shadow cast by the same taper at 152 inches from the screen was found by Mr. Chevallier to be equal to the shadow cast by the moon on November 3, 1851, when she was 10 days old, and had past the meridian one hour, shining very brightly. The shadow cast by the taper, where there was no extraneous light, was very faint at 576 inches, but was discernible at 828 inches.

It would seem that the sky during the total eclipse was considerably brighter than in ordinary moonlight.

Mr. Chevallier furnishes the following account by an observer who accompanied him. The telescope used was a clearly defining astronomical telescope,—aperture $1\frac{1}{2}$ inches, focal length 18 inches, power about 10. When the sun was a good deal hidden, there was nothing of the dark limb of the moon seen.

As the sun disappeared, four black bands were seen which crossed the fine crescent.* "The moment it became dark, the corona appeared. It was of a pale yellowish colour; a bright ring about one-seventh of the moon's diameter nearest the moon; and light rays of the same colour branching out all round beyond this, to rather more than half the moon's diameter. The limit of the bright ring was distinct; but the rays faded away so as to leave no definite edge to the outer part. It was very bright where the sun had disappeared, and was darker where the sun afterwards reappeared. The corona was of the same breadth all round, and

* The illustrative drawing represents these bars as being very much like the phenomena described by Baily, fig. 3.

was very well seen and examined by the naked eye. There was light enough to make and read pencil notes without difficulty, the paper being laid on the table. *Venus* and *Mercury* were quite bright."

At the reappearance, the same black bars, across what seems to have been the narrow crescent of the sun, were seen as before. As the sun advanced, these bars became narrower and narrower, and, finally, quitted their hold altogether. The appearance is compared to that shown by a piece of thin India rubber, when it is torn in two, and little pieces give way before the rest. "The edge of the sun had a totally different appearance in coming out and in going in. Then, it was a definite, smooth portion of a circle; now, one part appeared first, then a little bit somewhere else, and it seemed to be 2^s before it assumed the appearance of a limb intersected by bars, and 3^s more before these bars quite disappeared."

"Distant objects and the outlines of the hills were quite visible during the darkness."

RAVELSBERG, 1 mile N.E. of ENGELHOLM.

Approximate Latitude, 56° 16′ N.; Approximate Longitude, $0^h\ 51^m\ 33^s$ E.

Observations by Mr. Hind.

Mr. Hind employed an excellent telescope by Dollond $1\frac{1}{2}$ inches aperture with a magnifying power of about 20.

First Contact $3^h\ 0^m\ 18^s$ Local M.T.; only approximate.

At $3^h\ 40^m$, the first indication of colour in the moon. She appeared of a dull coppery red, and her outline could be traced all round. No spots on the moon's surface were visible, but the limb was exceedingly rough, especially one gap near the southern cusp. The definition was excellent throughout.

"Shortly before the commencement of totality, a large mountain close to the south cusp suddenly appeared to shoot forward and connect itself with the sun's limb, leaving a very small lunular portion of his disc visible south of the bright crescent; a few seconds later, the same appearance was noticed in respect to other irregularities on the moon's limb, and BAILY's *beads* were formed. The remaining portion of the sun's illuminated disc presented something of the appearance of a string of luminous beads, *but of irregular size and shape;* the largest corresponding to the gap or valley near the south cusp, already mentioned. It was impossible, in viewing the phenomenon under the most admirable sharpness of vision I ever witnessed, to avoid the conclusion, that Baily's beads are caused by the sun shining along the valleys, and between the mountain ridges on the limb of our satellite, the effect being greatly aided by irradiation."

Five seconds after the totality commenced, the corona was looked for and seen conspicuously. Its colour was that of *tarnished* silver, owing perhaps to the intervention of a thin cloud. The breadth of

the corona was about one-third of the moon's diameter. Rays of light extended through and beyond it, but no trace of circular motion. It was visible on the western side for at least 5 seconds after the sun reappeared.

After the totality commenced, " three rose-coloured prominences immediately caught my eye, and others were seen a few seconds later. The largest and most remarkable was situated about 5° north of the parallel of declination on the western limb (275°) :" it was straight throughout two-thirds of its length, and curved, like a sabre, near its extremity; the concave edge towards the horizon. The edges were of a full rose-pink ; the central part a paler pink. About 20^s after the disappearance of the sun, I estimated its length at 45″; towards the end of the totality it was perhaps 2′; the moon having apparently left more and more of it visible as she travelled across the sun. I perceived no change of form or motion, and it was visible 4^s after the sun reappeared, but detached from the sun, the strong white light of the corona being visible between it and the sun." (See fig. 6 and Mr. Dawes' sketch).

A triangular detached spot of the same colour was seen suspended in the light of the corona about 10° to the south (at 265°). The moon moved *away* from this detached portion, which preserved its relative position to the sabre-like mountain. " On the south limb of the moon (from 150° to 240°) appeared a long range of rose-coloured flames, which seemed to be affected by a slight tremulous motion. The bright rose-red of the tops of these prominences gradually faded towards their bases, and in their place a bright narrow line of a deep violet tint appeared along the moon's limb. In this range there was, towards the western end, one eminent projection (about 210°), and one of a similar form and size at 145°. These might be about 40″ high." Mr. Hind's drawing corresponds very well indeed with that of Mr. Dawes.

The surface of the moon was reddish purple at the beginning of totality, which changed to a dull purple. A bright glow, like twilight, indicated the place where the sun was about to emerge. Three or four seconds later, the beads again formed, instantaneously, but less numerous and more irregular than before. In about 5^s more, the sun appeared as a fine crescent, and the *beads* were suddenly extinguished. Ten minutes later, the sky clouded up.

During the totality, the corona seen by the naked eye was by no means brilliant. The darkness was not like that of night; the landscape seemed to be overspread with a dark olive tint; yet distant objects seemed visible at a greater distance than they would be under the same degree of darkness in the evening.

Observations by Mr. Dawes.

Mr. Dawes observed at the same place with Mr. Hind, but the observers kept themselves clear of all communication during the eclipse.

Mr. Dawes used an excellent achromatic by Dollond, aperture 1·6 inches, and focal length 22 inches. The eye-piece principally employed magnified 29 times, with a field of about 1° 36′. The

movement was equatoreal and steady. In the centre of the field of this eye-piece were two stout spider-lines at right angles to each other, and a wire, subtending an angle of 58″ in thickness, also crossed the field parallel to one of the spider-lines, and at some distance from the centre of the field. The only spots seen were a small group, about 1′ or 2′ from the western edge of the moon, in the north-west quadrant, and another very near the eastern edge, at about 88°.

First Contact $3^{h}\ 0^{m}\ 16^{s}$ Local Time,

Excellently observed, but the error of the watch only approximately known.

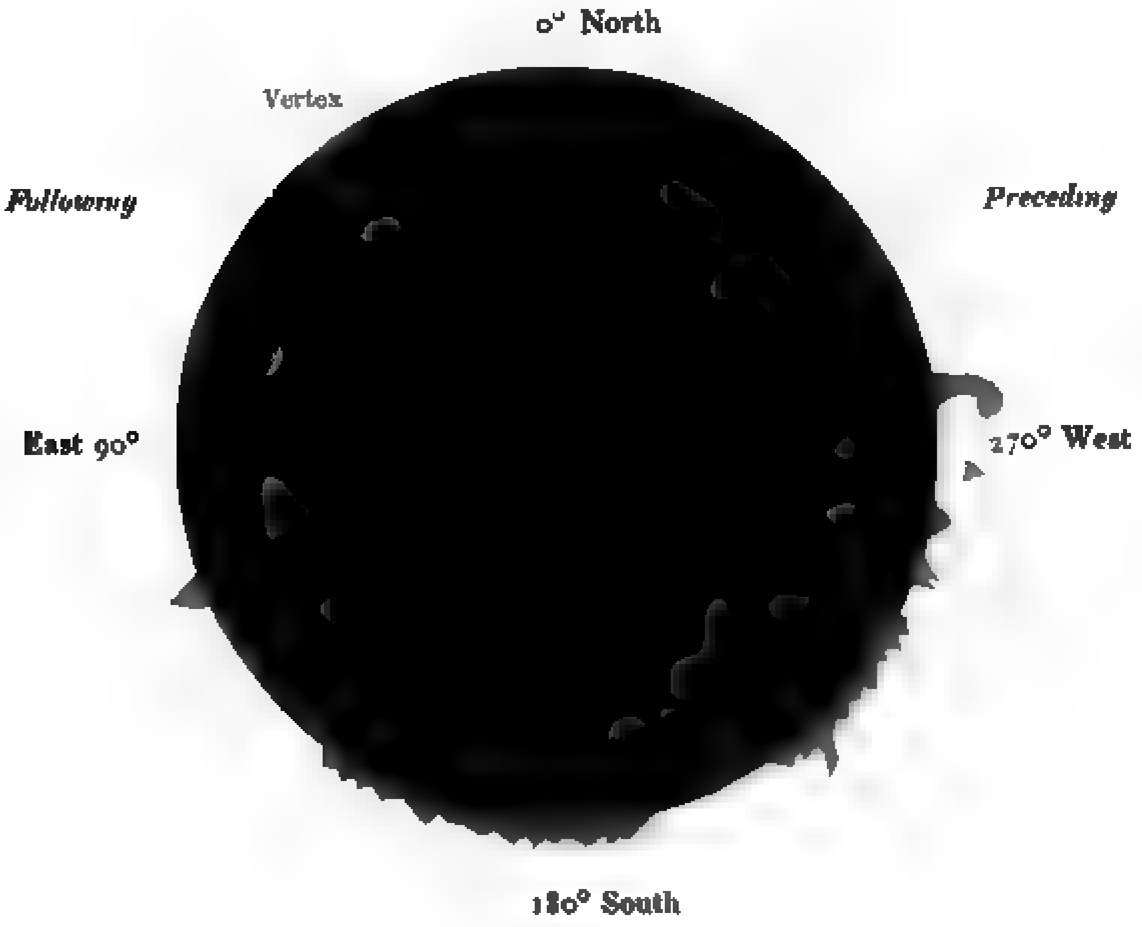
" The moon's advancing limb was seen to be extremely uneven. A remarkably large mountain was noticed about 15° of the moon's circumference to the south of the point of first contact."

At $3^{h}\ 54^{m}$ a light cloud covered the sun without apparently injuring the definition; at $4^{h}\ 1^{m}$ the light in the field of the telescope was remarkably blue. Repeated and varied attempts were made to ascertain whether the edge of the moon was illuminated, " *but no illumination of the moon's limb was ever perceived.*"

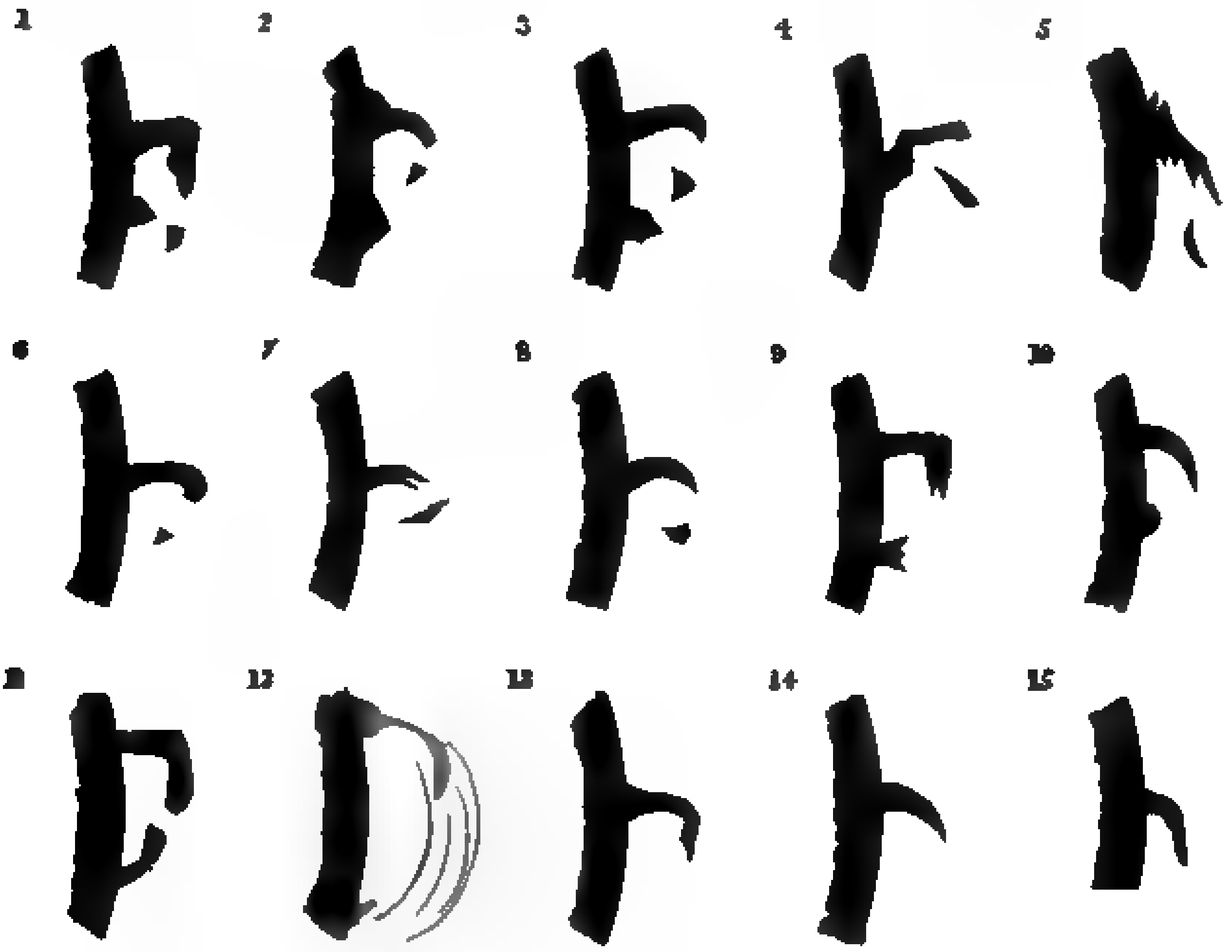
" About one minute before the disappearance of the sun, a portion, perhaps $1'\frac{1}{2}$ in length, was separated from the rest of the very narrow crescent at its southern extremity, by the protrusion of a remarkably large mountain in the moon's border. In a few seconds afterwards, a very small piece at the point of the same cusp was separated from the portion already cut off. About 3^{s} or 4^{s} before the totality, the fine crescent was broken up into numerous pieces or *beads*, I think about eight or ten; but they did not all appear at the same instant; they were not round, and were very unequal in length, *the dark intervals between the bright portions corresponding exactly with the positions of the mountains on the moon's edge, and evidently caused by them.* These intervals were largest towards the southern extremity of the crescent. I was particularly struck with the fact that the lunar mountains broke through the crescent, while it yet appeared to be considerably broader than the extent of their own projection beyond the general outline of the moon's circumference. This was very observable in the case of the largest of them, which divided the crescent so long before it seemed capable of doing so, as to take me quite by surprise. The lunar mountains had thus the appearance of *being drawn out into narrow black threads*, reaching to the exterior edge of the sun. This curious phenomenon I attributed, on subsequent reflection, to the effect of irradiation, which, increasing the apparent breadth of the brilliant narrow crescent, consequently increased to the same extent the apparent length of the prominences which broke through it."

The corona did not show itself instantaneously to Mr. Dawes on the disappearance of the sun, which he supposes might be owing to a short insensibility of the retina, as he observed the disappearance of the beads without a dark glass. It appeared in about 1^{s} or $1^{s}\frac{1}{2}$ after the totality. The extreme breadth of the corona was about

Total Eclipse, July 28, 1851, from Mr. Dawes' Sketch.



Remarkable Prominence, as seen by different Observers.



half the diameter of the moon, and about one-third of this nearest the sun was much brighter than the outer portion, which gradually faded away. The constitution of the corona was somewhat flocculent, not annular, nor intersected by rays, except towards the edge.

"From 0° to 90° no visible protuberance: at about 115° a large deep rose prominence of a regular conical form was observed: it was perhaps 1′½ in altitude at first, but was gradually covered up as the moon advanced; the colour fainter in the middle than on the edge (see the plate, which represents Mr. Dawes' sketch).

"At about 145° commenced a low ridge of red prominences, resembling in outline the tops of a very irregular range of hills. The highest did not probably exceed 40″. This ridge extended to about 197°, its base was the sharply defined edge of the moon. The irregularities appeared permanent, though there was an undulation from the west to the east, probably owing to our own atmosphere."

"At 220° commenced another low ridge of the same character, extending to about 250°, less elevated and less irregular in outline than the former, except that at about 225° a very remarkable protuberance arose from it, to an altitude of 1′½, or even more. This was in form like a dog's tusk, the convex side north and the concave south, and the apex acute. The tint of the lower range was a rather pale pink, the colour of the higher prominence was deeper and brighter."

"A small double-pointed prominence was seen at 255°, and a low one, with a broad base, at 263°. These were of the same colour, but paler, than the height just noticed. At or very near 270°, appeared a bluntly triangular pink body, *suspended*, as it were, in the corona. This was separated from the moon's body when first seen, and the separation increased as the moon advanced."

"To the north of this, at about 280° or 285°, appeared the most wonderful phenomenon of the whole. A red protuberance of vivid brightness, and very deep tinted, arose to a height of 1′½ perhaps, when first seen, and increased in length to 2′ or more, as the moon's progress revealed it more completely. In shape it somewhat resembled a *Turkish cimeter*, the northern edge being convex, the southern concave. Towards the apex it bent suddenly to the south, or, as seen by the telescope, upwards. Its northern edge was well defined, and of a deeper colour than the rest, especially towards its base. I should call it a *rich carmine*. The southern edge was less distinctly defined and decidedly paler. It gave me the impression of a somewhat conical protuberance, partly hidden on its southern side by some intervening substance of a soft or flocculent character. The apex of this protuberance was paler than the base, and of a purplish tinge; and it certainly had a flickering motion. Its base was from first to last sharply bounded by the edge of the moon. To my great astonishment, this marvellous object *continued visible for about* 5^s, as nearly as I could judge *after the sun began to reappear*, which took place many degrees to the south of the situation it occupied on the moon's circumference. It then rapidly faded away, but *it did not vanish instantaneously*."

"The arc from about 283° to the north point was entirely free from prominences and also from any roseate tint."

Mr. Dawes desires not to speak very positively as to the length of the protuberances; besides the difficulty of estimation, they changed in size, owing to the moon's motion. The colour of the moon during the totality was a purplish black. Immediately after the sun's reappearance, the thermometer stood at 57°.

Mr. Dawes counted the beats of his watch from the beginning of the totality till 20^s had elapsed; but on looking at the watch the seconds were not visible. A pencil, which was accidentally dropped upon the ground, was not distinguishable.

"At the reappearance, the interruptions of the narrow luminous line were very few and small; only two or three at irregular intervals were noticed. On examining this part of the moon subsequently, it was found to be free from obvious irregularities.

"The duration of the total obscuration was probably about a minute and a half."

HELSINGBORG, $2\frac{1}{2}$ miles due East of Elsineur Castle.

Lat. 56° 4′ N.; Long. 0^h 51^m E. (by map).

Observations by Capt. F. W. Blackwood, R.N., and Lieut. Goodenough, R.N.

The telescope was a good one by Fraunhofer,—aperture 3 inches, all of which was used, power 32. The dark glass was one of neutral tint, which gave a clear image. Time was obtained by altitudes of the sun with a good sextant and mercurial horizon.

At first, the clouds were light and fleecy; but about 2 P.M. they became thicker, and interfered with the observation.

First External Contact at 3^h 1^m 7^s Local M.T.; a little doubtful.

The advancing limb of the moon appeared very rough, especially near her *upper* cusp.*

At 3^h 40^m the clouds increased, the light was now sensibly diminished, the cusps sharp.

The Totality took place at 4^h 3^m 35^s Local M.T.; correct.

A hazy appearance of bright light made its appearance round the whole circle of the moon excepting at the upper part, where for a space of about 70° the limb was surrounded by a narrow crescent of a reddish violet tinge, something like the flame from a coke fire. "There was no *aureole*, or rays shooting out; it was simply a band of white light surrounding the moon." "One red prominence only was seen about 20° to the left of the moon's vertex, and rising to a height of 2′." "This red prominence had no decided outline; it was wavy and irregular in form, rather like a flame seen through a medium of hot air. (See fig. 4). The sun reappeared too soon to allow of a careful scrutiny of the whole limb, as the totality did not last above 30^s, if so long."

* The description by Captain Blackwood applies to the objects as seen in the telescope which inverted.

Surprise and the early reappearance of the sun prevented the accurate observation of this phenomenon, or of the red prominence. The sun was soon after clouded up.

Christianstadt.

Lat. by map 56° 4′; Long. $0^h\ 56^m\ 40^s$ E.

Observations by Mr. Humphreys.

Mr. Humphreys, of Caius College, Cambridge, who was formerly an assistant at the Royal Observatory, having offered to assist Mr. Airy in observing the eclipse, was requested to station himself at Christianstadt, on the east of the central line, as a balance to Mr. Dunkin, who was at Christiania, on the west. The position selected was an old redoubt in the drilling-ground, about quarter of a mile W. by N. of the town.

The telescope used was a signal-station telescope, *non-inverting*, power about 25.

First External Contact $2^h\ 9^m\ 27^s$* by chronometer; Arnold, 1790.

The sun was hidden by clouds for about 17^m after the first contact, and also for 8^m after $2^h\ 34^m$. After this time, though the sun's disc was occasionally hazy, the observation was not seriously obstructed. When the sun was half eclipsed, the light had diminished sensibly; at $2^h\ 45^m$, the flame of a candle held up before the sun was visible. At $3^h\ 0^m$ an irregularity in the moon's limb, like an indent, was observed near the lower cusp. No portion of the moon external to the sun was seen before the totality, nor were any "*beads*" seen; but the last lune of the sun seemed to glisten as it disappeared.

Beginning of Totality $3^h\ 12^m\ 4^s$ by chronometer; Arnold, 1790.

The corona seemed now to form all at once, and to be concentric with the sun. It presented the appearance of a succession of annuli, which altogether were half the moon's radius in width. It appeared faintly coloured; and equidistant brushes of light, 6 or 7 in number, of a very light violet, appeared in streamers from the the corona, and converging to a point.

A red prominence was seen at 40° from the vertex towards the east. This was estimated at about 30″ altitude, and it disappeared very soon. The hook-shaped prominence (fig. 7) showed itself at about 135° from the vertex towards the west. This became longer and brighter as the eclipse advanced; it was curved, with the point downwards, and ended in a double tongue. The height was estimated at 50″. It was accompanied, a little below the extremity of the hook, by an equally bright and similarly coloured *detached* portion, somewhat like a spider. As the totality continued, two more prominences made their appearance at about 150° and 160° respectively, from the vertex towards the west. These

* The rates of the chronometer between Greenwich, Altona, and the return to Greenwich, are not sufficiently good to allow the times by chronometer to be reduced to Greenwich time.

prominences were of a beautiful rose colour; the southern edges of those which were based on the moon glistened with a white bright light. The detached portion had this appearance on its northern edge, and the white light of the corona separated it from the hook-shaped portion, and from the moon's limb.

A few seconds before the reappearance of the sun, the moon's edge seemed glistening, and there was some doubt whether the sun had not actually reappeared.

End of the Totality $3^h\ 14^m\ 50^s$ by Arnold, 1790.

For a few seconds after the reappearance, the whole circumference of the moon was distinctly visible, appearing to glitter with a white light.

The last External Contact $4^h\ 13^m\ 27^s$ by Arnold, 1790.

Thermometer Readings.

h m	Black Bulb. °	Dry Therm. °	Wet Therm. °
2 10	75·5	69·0	60·0
3 0	66·0	64·2	57·0
3 15	60·5	62·0	55·6
4 30	71·0	65·0	58·2

Observations by Mr. Miland.

Mr. Miland accompanied Mr. Humphreys, and their observations are generally in accordance.

Mr. Miland did not see the indent near the south cusp.

	h m s	
Beginning of Totality......	3 10 0	by M'Cabe, 194.
End	3 12 45	
Last External Contact ...	4 12 0	

At $2^h\ 29^m\ 30^s$ the flame of a candle was visible before the sun. Some difficulty was felt in reading the chronometer during the totality, and a lighted candle was very gladly resorted to.

The corona, though white at first, appeared afterwards tinted with pale blue.

Observations by Colonel Silverstopfe.

Some few minutes before the total eclipse the wind fell, and the weather was calm.

By a stop-watch, the duration of the totality was found to be $2^m\ 41^s{\cdot}7$.

The corona was light violet, nearly white, and not quite regular, but in parts waved. *Venus* was the only star seen during the total darkness. The increase of light when the sun reappeared seemed to proceed more rapidly than did the decrease. The progress of the shadow over the country could not be seen, only the variation of the light. The eclipse lasted $2^h\ 4^m$.

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ROYAL ASTRONOMICAL SOCIETY.

VOL. XII. *February* 13, 1852. No. 4.

THE Annual General Meeting of the Society, J. C. ADAMS, Esq., President, in the chair.

Rev. Thomas Allen Southwood, Cheltenham College, and
John Dillwyn Llewelyn, Esq., Glamorganshire,
were balloted for and duly elected Fellows of the Society.

Report of the Council to the Thirty-second Annual General Meeting.

The return of the period at which it is the duty of the Council to address their constituent body often suggests a few words on the history of the Society, and of the science which it is intended to promote. When the founders of our association circulated their first address, explanatory of their views and objects, they thought it desirable to make something like an apology for encumbering anything so perfect as astronomy with help. "It may be conceived by some," they said—and we know the figure to mean that some had so conceived—"that astronomy stands less in need of assistance of this kind than any other of the sciences; and that in the state of perfection which its physical theory has already reached, its ulterior progress may safely be trusted to individual zeal, and to the great national establishment exclusively appropriated to celestial observations." Perhaps our founders, at that time, were not fully aware that when theory treads on the heels of observation, it shows that observation has either relaxed its diligence in collecting, or neglected to make use of its stores; perhaps they could hardly guess that the unused records of the great national establishment could, by themselves, have been made to prove the latter; perhaps they would not have ventured to anticipate that the Society they were founding would, in thirty years, see such additions made to both theory and practice as would encourage their successors to affirm that progress could never end. But they had sufficient anticipation of the future to let no assertion of an existing finality disturb them in their course; and every succeeding year gives fresh proof of their sagacity. That which has just elapsed is no exception to the rule, either with reference to the science or our own Society; though, as to the latter, it has been saddened by the loss of two most efficient members of the actual Council.

The Report of the Auditors, subjoined, will show the state of the finances:—

RECEIPTS.

	£	s.	d.
Balance of last year's account	330	7	11
½ year's dividend on £2163 12s. 6d. 3¼ per Cents	37	5	10
½ ditto on £2449 5s. 4d. ditto	38	12	10
1 ditto on £1150 Consols	33	10	0
On account of arrears of contributions	81	18	0
86 contributions (1851–52)	180	12	0
3 ditto (1852–53)	6	6	0
10 compositions	210	0	0
25 admission fees	52	10	0
18 first year's contributions	34	13	0
Sale of Memoirs, &c.	55	15	8
	£1061	11	3

EXPENDITURE.

				£	s.	d.
Cash paid for investment of 7 compositions				147	0	0
George Barclay, for printing Memoirs, Vol. XIX.				127	15	2
Ditto ditto Vol. XX. and Monthly Notices				252	15	0
George Richardson, plasterer				10	14	0
J. Charlton, map case				9	10	0
J. W. Rumfitt, bookbinder				11	16	5
Taxes { 1 year's property tax	1	9	2			
Taxes { 1 year's assessed tax	6	9	5½			
				7	18	7
J. Williams, 1 year's salary as Assistant-secretary				100	0	0
Ditto commission on collecting £411 14s. 8d.				20	11	6
Charges on books, and carriage of parcels				6	7	11
Postage of letters and Monthly Notices				28	17	9
Porter's and charwoman's work				12	11	8
Tea, sugar, biscuits, &c. for evening meetings				13	13	0
Coals, candles, &c.				12	18	6
Sundry disbursements by the Treasurer				23	0	10
Balance in the hands of the Treasurer (Jan. 1852)				276	0	11
				£1061	11	3

Assets and present property of the Society:—

				£	s.	d.
Balance in the hands of the Treasurer				276	0	11
Due from Mr. Byng	£22	6	0			
1 contribution of 7 years' standing	14	14	0			
1 ——— of 6 ditto	12	12	0			
4 ——— of 4 ditto	33	12	0			
4 ——— of 3 ditto	25	4	0			
15 ——— of 2 ditto	63	0	0			
23 ——— of 1 ditto	48	6	0			
				219	14	0
Due for publications of the Society				2	16	0

£1150 3 per Cent Consols.
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Unsold publications of the Society.
Various astronomical instruments, books, prints, &c.

Stock of volumes of the *Memoirs*:—

Vol.	Total.	Vol.	Total.	Vol.	Total.
I. Part 1	45	V.	186	XIII.	274
I. Part 2	90	VI.	204	XIV.	460
II. Part 1	106	VII.	229	XV.	246
II. Part 2	72	VIII.	215	XVI.	270
III. Part 1	135	IX.	222	XVII.	265
III. Part 2	155	X.	235	XVIII.	282
IV. Part 1	157	XI.	245	XIX.	301
IV. Part 2	172	XII.	256	XX.	342

Progress and present state of the Society:—

	Compounders.	Annual Contributors.	Non-residents.	Patroness, and Honorary.	Total Fellows.	Associates.	Grand Total.
February 1851	125	161	66	6	358	60	418
Since elected	6	26	...	...	32	...	32
Deceased	−1	−4	−1	...	−6	−2	−8
Removals	4	−4	...	...	...	...	...
Resigned	...	−1	...	...	−1	...	−1
February 1852	134	178	65	6	383	58	441

The instruments belonging to the Society are now distributed as follows:—

The *Harrison* clock,
The *Owen* portable circle,
The *Owen* portable quadruple sextant,
The *Beaufoy* circle,
The *Beaufoy* transit,
The *Herschelian* 7-foot reflector,
The *Greig* universal instrument,
The *Smeaton* equatoreal,
The *Cavendish* apparatus,
The 7-foot Gregorian reflecting telescope (late Mr. Shearman's),
The Universal quadrant by Abraham Sharp,
The Variation transit (late Mr. Shearman's),
The *Fuller* theodolite,

are in the apartments of the Society.

The Brass quadrant, said to have been *Lacaille's*, is in the apartments of the Royal Society.

The Standard scale is in the charge of the Astronomer Royal, with the consent of the Council, to be employed in the construction of a new Standard Measure, under the direction of the Standard Committee.

The remaining instruments are lent, during the pleasure of the Council, to the several parties undermentioned, viz.:

The *Beaufoy* clock, } to the Royal Society.
The two invariable pendulums, }
The *Wollaston* telescope, to the representatives of the late Professor Schumacher.
The other *Beaufoy* clock, to Mr. J. Drew.
The *Lee* circle, to Captain Blackwood.

The twentieth volume of the *Memoirs*, and the accompanying and supplementary eleventh volume of *Monthly Notices* for the Session 1850–51, have been published some time. In the former are several papers from Mr. Maclear, which show how zealously and usefully he discharges his duty as Her Majesty's Astronomer at the Cape of Good Hope. These, with the exception of the paper on the "Parallax of *α Centauri*," are printed at the expense of the Government, as coming properly under the head of Cape Observations.

Mr. Maclear's account of the continuation of the measurement of an arc of the meridian at the Cape to stations where local disturbances of attraction are little probable, is very interesting, and we believe that the results of this most arduous undertaking will bear a comparison with those of a similar nature under more favoured circumstances. But without some very considerable additional aid in computation, it will not be possible to prepare and publish this standard work in any reasonable time. The great expense is already incurred, but no available results can be presented, until the whole of the observations have been carefully, and completely, and systematically reduced. This arc of the meridian is, we believe, the only arc which has yet been measured in the southern hemisphere with first-rate apparatus, and Mr. Maclear, with prudent foresight, laid at the same time the basis for a trigonometrical survey of a large part of the colony.

In the Catalogue published by the British Association, under the direction of Mr. Baily, the materials for the places of the southern stars were found to be very defective; perhaps the only Catalogue to be then thoroughly depended on was Mr. Johnson's Catalogue of Stars observed at St. Helena. Mr. Maclear has undertaken to revise all those stars in the B.A.C. which have not

been sufficiently determined already; and in the volume of our *Memoirs* just published, there is a large list of rectifications, which a paper since received has considerably increased. In many cases, from an examination of the original data of Lacaille's *Cœlum Australe*, Mr. Maclear has been able to suggest the cause of error. This interesting inquiry has been, perhaps, pushed by Mr. Maclear to its full limit, considering the data on which Lacaille's catalogue is founded, and the manner of its formation; but a Cape observer would be an astronomer of a very different temperament from Mr. Maclear, if he did not think the correction of a slip of Lacaille's pen a sufficient reward for a serious and laborious investigation.

The determination of the parallax of *α Centauri* is a good specimen of resolute and intelligent research, well rewarded by the importance of its results. Mr. Henderson first called attention to the probably large parallax of this star, and Mr. Maclear has determined the amount at two different epochs, the latter of which is recorded in our last volume. On the evidence of this memoir it seems that the parallax of this fine double star is $0''\cdot92$, with great certainty. The observations, so far as we can see, admit of no constant error, nor of any error obeying a law: that casual error is sufficiently eliminated by the immense mass of observations, is evident from the small amount of probable error. Perhaps it might be worth while to ascertain the non-influence of refraction upon the observations, by comparing *α Centauri* with stars in the same parallel; but no conceivable error in the refraction could much affect Mr. Maclear's results. From the mode of observation, temperature can have little influence on the instrument or its microscopes. Mr. Maclear proposes to continue these researches with the circle in the same way as he has hitherto done, and also to employ his new equatoreal in measuring the relative positions of the component stars. The difference of declination determined with the equatoreal will give an additional check on the circle observations.

Mr. Maclear's numerous friends will be glad to hear that he has, to a considerable degree, recovered from the harassing and distressing service of conducting the measurement of the arc of meridian, and that his able and intelligent assistant, Mr. Mann, is also restored to health. But we would venture to remark that an addition to the ordinary computing force of his establishment would not only tend to preserve these zealous men from manifest risk of overstraining themselves, but would very much increase their utility by enabling them to devote their whole attention to worthy objects.

During the past year, the astronomical world has been interested by the successful attempt of Foucault to prove, mechanically, the rotation of the earth by means of the vibrations of a very long pendulum. The general solution of this problem was simultaneously given by several eminent mathematicians, and the velocity of rotation at any point of the earth's surface was theoretically deduced by them. But, amongst the practical difficulties in making

the experiment successfully, the greatest was to get rid of the rapid motion of the apse, which invariably takes place when a pendulum subject to any disturbance describes a very long ellipse. With whatever care the pendulum was suspended and set swinging, it was generally impossible to make it describe an exact plane and to prevent all disturbance of its point of suspension; and the consequence was, that the apsidal motion was in many instances so confounded with the apparent azimuthal rotation of the plane of vibration, that the most contradictory results were produced. The Astronomer Royal, to whom we are indebted for so many valuable papers on similar subjects, has treated the subject with all the generality that it admits of, and has succeeded in giving simple rules, by which the effect of the apsidal motion arising from faulty suspension or from elliptic path may be got rid of.

The Council also beg to call particular attention to an elaborate discussion of the elements of the planet *Mars*, by Mr. H. Breen, of the Royal Observatory, Greenwich, who is well known as an able and zealous computer. The ancient Greenwich planetary observations, which have been now for some years rendered available by the labours of the Astronomer Royal, have been made excellent use of by Mr. Breen, not only with regard to *Mars*, but *Venus* also; and the elements of the orbits of both these planets are determined for definite intervals of four years from the epoch of Bradley's observations to nearly the present time. In the case of *Mars*, the whole of this work is due to Mr. Breen; in the case of *Venus*, he completed the determination of the elements from the ancient observations which had been begun by his father.

The *Monthly Notices* have been conducted on the same plan as in former years, with perhaps a still greater tendency to include in them such papers of moderate length as do not require illustrations or tabular matter. This increases our printing expenses somewhat and our postage a good deal. Perhaps, as long as the funds of the Society allow us to be liberal, there is no need to be very anxious to reduce the cost, if we thereby reduce the quantity of information or the circle of its extension. But it may not be amiss to suggest a plan by which, if it met general consent, a good deal of trouble, and perhaps some expense, might be saved. The *Astronomische Nachrichten* publishes almost all our observations and more than all our ephemerides, earlier and more punctually than we can do, at shorter intervals, and throughout the year. By the present arrangement, which it only depends on the members to keep up, this unrivalled periodical is sent regularly by post, without any extra charge beyond the very moderate subscription. If we suppressed that portion of the *Notices* which is made up of observations and ephemerides, and which would find their proper place in the *Nachrichten*, we should save a good deal of expense, and, at times, useless printing, besides giving our assistance to the journal which has done, and is doing, more for astronomy than can be accomplished by any other means.

As the dispute between Denmark and the Duchies seems happily to have terminated, we may hope that the King will resume the position held by his predecessors as an especial patron of our science. It is, however, the duty of the Council to impress upon its members, and, if necessary, through their means upon the public, that the *Astronomische Nachrichten* is now an astronomical requisite, and must be supported by those who wish well to the progress of astronomy.

Amongst the contributions to our *Monthly Notices* during the present year, not the least remarkable is a paper by the Astronomer Royal on the relative stability of the altazimuth instrument at Greenwich. Soon after its erection it was found that the steadiness of the azimuthal zero was not so satisfactory as the massive construction of the instrument, and the undoubted excellence of all the mechanical arrangements, had led him to expect. Suspicion first fell naturally upon the instrument itself, and means were devised for preventing any reaction of the centre-work in the rotation of the instrument. This proving of no avail, a collimating mark was set up, which, by the steadiness of the readings in azimuth, showed that the fault did not rest exclusively in any want of steadiness of the azimuthal circle of the altazimuth instrument. The only remaining supposition was evidently that the time transmitted from the transit instrument of Troughton (then in use) was incorrect, either from faulty determinations of its errors of adjustments, or from faulty comparisons of clocks, or from both these circumstances combined. After having obtained a long series of readings of the collimator and simultaneous determinations of azimuthal zero by observations of stars, the Astronomer Royal devised a method for applying the calculus of probabilities to determine the relative proportions of the three classes of independent errors with which he had to deal, viz. 1st. Instability of the azimuthal circle; 2dly. Instability of the collimator; 3dly. Uncertainty in the time transmitted from the transit instrument. Independently of the abstract value of the solution of a problem of this class, the results which have been deduced have a very great interest, as affecting the standard observations of the present time. It was found, in fact, that the chief part of the errors in question were entailed by the transmission of time from the transit instrument, the error due to the assumed instability of the azimuthal instrument being only one-seventh part of that due to the faulty transmission of time. To the full belief in this fact by the astronomers of Greenwich generally, even before the accurate solution of the problem, we owe, amongst other reasons, the great transit circle, which has occupied the places of both the transit instrument and mural circle, and the assurance that similar principles with regard to massiveness and firmness of construction must ultimately be adopted in the construction of all first-class instruments.

During the past summer, amongst other astronomers and sci-

entific gentlemen attracted to our shores by the Great Exhibition, we have received a visit from Mr. G. P. Bond, the zealous and able observer at the Harvard Observatory, Cambridge, Massachussetts. While here, he exhibited at the Society's apartments the galvanic apparatus for observing transits, which has been for some time in use at that Observatory. By his kindness and anxiety to give an accurate knowledge of the construction and mode of action of the apparatus, the members of this Society have had the best possible opportunity for learning the details of its management, and of the success which had already attended its operations in America. Since it is probable that this mode of registration of transits will ultimately supersede all others, we cannot too fully acknowledge the courtesy of Mr. Bond individually, and of the Directors of his Observatory, who authorised his mission, for their courtesy and desire to make us as soon as possible participate in this the greatest improvement, probably, that has been made during the present age in the means for making and multiplying accurate observations, and for determining with absolute accuracy the longitudes of all stations, however distant, which can be connected by wires.

The want of some fixed standards for the better determination of the magnitudes of stars has for a long time been sensibly felt by astronomers, and it is, therefore, gratifying to find that considerable attention has been recently paid to the subject. Independently of the researches of Sir J. Herschel and Mr. Johnson, we would call attention to a remarkable paper by Mr. Dawes, in the recently published volume of our *Notices*, as containing the practical details of a method of photometric comparison which has the merit of being very simple and easily applicable by every one provided with a telescope. The principle is the same as that in other methods which have occasionally been proposed; that is, it proposes to diminish the light of all stars compared, so as to reduce them to some common standard of brightness. Mr. Dawes proposes to diminish the aperture of the telescope employed till the star under comparison becomes barely, but steadily, visible, and to take as the standard aperture that which just secures visibility to the average of several of Argelander's stars of the sixth magnitude. Assuming then the obvious principle that if two stars, as viewed through a telescope, appear equally bright, the illuminating powers employed (that is, the areas of the portions of the object-glass employed) must be inversely proportional to their magnitude or real brightness; it is easy to calculate the areas of the portions that must be left exposed to render *just* visible the stars arranged according to a definite scale of magnitudes, and to provide a series of pasteboard rings that can be readily numbered and applied, by means of the formula given in the paper. Such a method in the hands of so vigorous and accurate an observer as Mr. Dawes cannot fail to lay the foundation for a correct and general survey of the heavens with regard to star-maguitudes, and to take from the science of astronomy

the arbitrary character which is attached at present to this branch of it.

Amongst foreign astronomers who have from time to time contributed to our *Notices*, none have been more constant or zealous in adding to our resources by observation or computation than Mr. Rümker of Hamburg. As increasing years and decline of health have, at length, compelled him to relax in his efforts for the advancement of astronomical science, and to contemplate retirement from his professional employments, we feel bound to express at this time our obligations to him for his incessant labours in the service of astronomy generally, and for his constant good-will and services to this Society for a long series of years. Mr. Rümker has been chiefly known to us for some years past for the active part which he has taken in the observations of the small planets and comets, which have been discovered in such rapid succession. His observations have been usually amongst the first contributions to the history of these minute and faint bodies, and he has not unfrequently been the first to make use of his own observations in the construction of orbits and ephemerides for the ease of other observers. In addition to these casual works, of a sufficiently laborious character, when added to his daily duties as Master of the Nautical School at Hamburg, the great work of Mr. Rümker is yet to be mentioned. In the year 1843 appeared the first part of a projected catalogue of 12,000 fixed stars, made chiefly for the purpose of filling up the gaps which remain in *Bessel's Zones* and the *Histoire Céleste*. This work is now nearly, if not quite, completed. The half of the remaining or fourth part, containing the stars lying between 18^h and 21^h of right ascension, appeared in 1849; and Mr. Rümker will, in all human probability, before entirely laying aside his astronomical duties, have the satisfaction of presenting the remaining portion to astronomers. In the present state of science, large catalogues of stars, especially of stars not very far removed from the zodiacal limits, are especially valuable to aid in the discovery of more of those small bodies, of which so many have been added to our planetary list; and such a work as Mr. Rümker's, executed by the sacrifice of all the leisure left to him by his strictly professional engagements, is a gratifying tribute to the scientific energy of the present age. We have only mentioned those works of Mr. Rümker which have been prominently brought before the notice of this Society; and it would be, perhaps, going beyond our province to offer any eulogium on his labours in the service of nautical astronomy, or in the more direct path of his professional duty. We have before us more than enough to justify this tribute to his unwearied industry, to his zeal and love for our science, and to the ability which has rendered his efforts useful to astronomy. The meeting will, without doubt, join the Council in wishing that the evening of Mr. Rümker's life may be spent in the happy consciousness of having materially added to the perfection and the enlargement of the noblest of the physical sciences, and that his son may continue

to tread in his footsteps, and to develope still further the energy and talent which he has already shown, and which promise to make him a worthy successor to his father.

The Council cannot, without the deepest regret, advert to the retirement of Mr. Riddle from their body, after an uninterrupted service of twenty-seven years. During this long period, no member of the body has been more regular in his attendance, or more willing to place the leisure left by an arduous and fatiguing avocation at the disposal of the Society. To this it is due that, on the many occasions on which Mr. Riddle has urged the length of his service as a reason for giving place to others, the Council have always felt that services of such value could not be dispensed with for such a reason. But increasing age and health worn out by long exertion have made it necessary to yield at last. We are happy to add that the Government has allowed Mr. Riddle to retire from his office on terms honourable to all; so that, if rest of mind and body should, as all will sincerely hope they may, restore him to full health, we may yet feel the benefit of his renewed co-operation.

The Council have awarded the gold medal to C. A. F. Peters, for his papers on the Parallax of the Fixed Stars, and on the Constant of Nutation. The President will announce the special grounds of this award in the usual manner.

The Society has to regret the loss, by death, of two Associates, M. Goldschmidt and M. Boguslawski; of two members of the Council, Mr. Galloway and Mr. Woollgar; and of the following fellows:—Mr. Peter Clare, Mr. Hill, Mr. Lockhart,* Rev. J. Maher, Lord Melville, and Sir W. Morrison.

Palm Henry Lewis Pruss von Boguslawski was born at Magdeburg, September 7, 1789. His father, who was captain in the regiment, "Prince Louis," and afterwards in the regiment, "Courbière," died in 1802. Boguslawski received his early education at the Cathedral School of Magdeburg, and was under the paternal care of Prince Louis, from his father's death up to the death of the Prince in the fatal fight of Saalfeld. Another true and tried literary friend of his father's, the Consistory Counsellor Dr. Benedict Funk, who for many years was rector of the Cathedral Gymnasium at Magdeburg, took a lively interest in the young Boguslawski, and especially contributed to his love for astronomy and mathematics, by introducing him to the personal acquaintance of Lorenz and Bode. Boguslawski's desire to give himself entirely to science was interrupted by the events of 1806, and altogether stopped by the surrender of Magdeburg to the French. He

* The recency of the death of Mr. Lockhart obliges the Council to postpone further notice till next year.

entered the army, as a volunteer, in the beginning of the campaign which was decided by the battles of Jena and Auerstadt. After this he lived with his friends and relations in the Mark till 1809, occupying himself chiefly with astronomical and mathematical pursuits. He then entered the artillery, newly organised by Prince Augustus of Prussia in the Silesian provinces. In 1811 and 1812, which he passed in the Royal School of Berlin, he improved his friendship with Bode, and under Bode's guidance completed several astronomical essays, which are inserted in the *Berlin Ephemeris for* 1815 *and* 1816. In 1812, Boguslawski joined the garrison of Glatz as lieutenant, but was soon called into more active service. In 1813, August 30, he was wounded and made prisoner at Culm, but escaped to Prague, where he was confined four months in consequence of his wounds. In the February of 1815 he joined the allied army in its French campaign. Soon after his return to Glatz, he was transferred to Breslau as First Lieutenant. In 1817, he quitted the army and became possessed of the knightly estate of Gross-Raarke, near Breslau, when he married Augusta Wolff, the daughter of an iron-master at Breslau, who survives her husband. By this marriage he leaves two sons and three daughters. From the date of his marriage up to 1830, Boguslawski was occupied with the management of his domestic affairs, though he still found time for astronomy, having, fortunately, recovered from a weakness in the eyes brought on by his compaigns. As his occupation did not turn out well, he sold his estate and returned to Breslau, where he was for a year employed in the civil service, in the division of Communal property. In the meantime, on the death of Professor Jungnitz, the direction of the Breslau Observatory was given to Dr. Scholtz, who, as he already held another professorship, advised that the practical working of the Observatory should be consigned to a special curator, and recommended Boguslawski as proper for that duty. The date of his appointment as Conservator of the Observatory is December 2, 1831. From this time his scientific activity had a wider sphere and became more generally known. The discovery of a comet in 1835, April 20, obtained for him the first of the gold medals awarded by the King of Denmark for the discovery of telescopic comets, and the Lalande prize of the Académie. The philosophical faculty of Jena forwarded to him in the same year the diploma of Doctor, *honoris causâ;* and he was admitted *ad eundem* by the Faculty of Breslau. In the same year he was the first, or one of the first, to rediscover Halley's Comet. In 1836, Boguslawski was nominated Professor Extraordinary of Astronomy in the University of Breslau.

He was elected an associate of many foreign scientific societies; of the Royal Astronomical Society, of the Academy of Cracow, of the Geographical Society of Berlin, of the Societies for Natural and Physical Research of Emden, Frankfort, Hamburg, Jassy, Marburg, &c. At Breslau, for many years in succession, he discharged the duties of secretary for the geographical section of the Silesian Society for Patriotic Cultivation. His unwearied

activity brought on an organic disease in the throat, which medical skill was unable to cure, and he died 1851, June 5, lamented by all those who had the opportunity of appreciating his scientific zeal and amiable disposition.

Professor Boguslawski paid great attention to practical astronomy, and recommended the use of a "difference-micrometer," of his own invention, which is described in vol. xv. of our *Memoirs*. He afterwards contrived a universal instrument, which was intended to embrace all the qualities required in an astronomical instrument. A model of this is to be seen at the Breslau Observatory, and it has been described in the *Transactions* of the Isis Society of Aix-la-Chapelle, and in the Arts Section of the Silesian Society (*Rep. Brit. Assoc.*, 1845, p. 6.) In 1845 he visited England, and was present at the meeting of the British Association at Cambridge, where he read a notice on the great comet of 1843, and on comets generally. Besides these purely astronomical subjects, Boguslawski paid unremitting attention to the phenomena of falling stars, so that Breslau became the central point for that class of observation. The Breslau Observatory being well furnished with magnetic instruments, chiefly on the recommendation of Humboldt and of the British Association, an extensive and valuable series of observations was carried on from 1836 to 1851 under Boguslawski's direction. Since 1846 the professor published yearly, under the title of *Uranus*, a synchronical ephemeris of phenomena, visible on the horizon of Breslau, which was found of great use to amateurs. In the number for 1851 are found the last labours of the professor upon the great solar eclipse, which he did not live to complete.

Charles Wolfgang Benjamin Goldschmidt was born at Brunswick, 1807, August 4, and received his early education in the schools of that town, principally at the *Collegium Carolinum*. In 1828 he went to Göttingen, where he commenced and prosecuted his studies in mathematics and astronomy with great success. In 1831 he gained the student's prize medal (which is given by the Philosophical Faculty), for the solution of a problem in the calculus of variations. In 1831, Nov. 5, he graduated as doctor in philosophy, and engaged himself as a teacher of mathematics at Hoffwyl in Switzerland, the well-known educational establishment of M. Fellenberg. Goldschmidt soon returned to Göttingen, where, in 1833, he acquired the "*veniam docendi;*" and on Harding's decease in 1834, was engaged as assistant at the Royal Observatory. In 1844, without changing his relation to the Observatory, he was appointed Professor Extraordinary in the Philosophical Faculty. Dr. Goldschmidt died 1851, Feb. 15, prematurely and very unexpectedly, from disease occasioned by some irregularity in the functions of the heart. This produced, from time to time, during the last few years, symptoms of cerebral congestion, apparently of an epileptic character.

In his university lectures, Professor Goldschmidt treated upon *finite and infinite* analysis, the calculus of probabilities, theoretical

astronomy, mathematical geography, and terrestrial magnetism. As assistant at the Observatory, he became associated with the illustrious Gauss in many of his scientific inquiries which relate to astronomy and magnetism.

His principal works are :—

Determinatio Superficiei minimæ rotatione curvæ, data duo puncta jungentis, circa datum axem ortæ. Göttingen, 1834. This is his prize memoir.

Treatise on Analytical Optics, by Professor J. C. Edward Schmidt, edited after the author's death by Benjamin Goldschmidt. Göttingen, 1834.

Atlas des Erdmagnetismus, according to the results of Professor Gauss' theory, by W. Weber and Goldschmidt. Leipzig, 1840.

Researches on the Magnetic Declination at Göttingen, published in the Göttingen *Studien*, 1845.

Many of Professor Goldschmidt's observations and calculations relating to magnetism and astronomy are published in the *Resultate* of the Magnetic Association of Göttingen, and in Schumacher's *Astronomische Nachrichten.*

In 1834 Goldschmidt embraced the Lutheran confession, and then prefixed the surnames of Charles Wolfgang to his original name of Benjamin. Some confusion might arise if this use of two surnames by the same person were not kept in mind.

John Webb Woollgar was born November 7, 1795, at Lewes, Sussex, and was educated at the grammar-school of that town, but his varied store of information was chiefly due to his own industry, and to the careful instruction of his parents, who were well qualified for the task of directing and assisting his inquiries. Being prevented by delicate health from joining in usual boyish sports, he sought for recreation in the study of mathematics and astronomy; and at the age of thirteen received a prize from the conductors of the *Juvenile Miscellany.* In trigonometry, which at that time did not form part of the ordinary school education, he was wholly self-taught.

He was destined for the practice of medicine, but the state of his health led to the abandonment of this intention, and he was articled to a solicitor in his native place, where he subsequently practised for many years. At an early age he evinced his love for literature in the office of secretary to the Lewes Literary Society, mainly founded by his father, and was elected an honorary member in acknowledgment of his services. Subsequently, in conjunction with a few other gentlemen, he established a Mechanics' Institute. These useful institutions were then little known or appreciated; and he had to contend with some opposition and much indifference, which, however, served only in this, as in other instances, to increase his energy and perseverance. In 1822 he married, and passed the next eighteen years in the practice of his profession, but during the whole of this period devoted a considerable portion of his time

to his favourite pursuits. He entertained a great desire to bring the slide-rule nearer to perfection, and to reduce it to general use: he was very conversant with the history and use of this neglected instrument, and proposed more than one extension and modification of it. His close application to this subject in the year 1826 nearly cost him his life, and he was compelled, by the order of his medical attendant, to relinquish his labours.

In addition to those above mentioned, other local institutions and societies received much of his attention. Amongst these may be particularised the savings' bank, and the Sussex Provident Society. The affairs of the latter, in its numerous branches, became much embarrassed, but were wound up by Mr. Woollgar, and his colleague Mr. Godlee, in a manner so satisfactory to the guarantors, that both were presented with a handsome testimonial. He gave also much consideration to the savings' banks' system generally, and the nature and operation of friendly societies; and on the former subject read a paper in 1844 at the York meeting of the British Association for the Advancement of Science. Of the great services rendered by these societies to the scientific world, he ever expressed himself deeply sensible; and through life embraced every opportunity of attending their meetings. The Society for the Diffusion of Useful Knowledge testified their sense of his zeal in the cause of literature and science by appointing him to their local committee.

In 1840 he retired from the practice of the law, and the pursuits which till then had occupied his leisure hours now became the business of his life. At the expiration of two years he was placed in the commission of the peace for the county, and was most active and efficient in the discharge of his duties. In 1850 he was elected on the Council of the Royal Astronomical Society, and immediately undertook to superintend the publication of a new catalogue of the Society's library. Before its completion, his health declined so perceptibly as to oblige him to intermit his labours; he, however, persevered, and had the gratification of completing his task, in the manner which the Council acknowledged in the last annual Report. This was his last work. His disorder (of the heart) increased rapidly; and in full consciousness of, and preparation for, his approaching end, he was removed on the 6th March, 1851.

Though no work of sufficient size to attract general notice emanated from his pen, it would be tedious to enumerate the pamphlets, tables, calculations, &c., on various subjects, by the publication of which he endeavoured to diffuse knowledge and to aid the social progress of man.

Mr. Woollgar's distance of residence from London, and consequent inability to be a regular attendant at our meetings, caused him to be comparatively little known to the generality of our Fellows, except as a gentleman who took much interest in astronomy. Partly from this, and partly from the feeling that it is expecting too much from non-residents in London, unless they are officially connected with astronomical institutions, to serve on

the Council, it was not until within two years of his death that Mr. Woollgar was placed on the list. In this capacity, the zeal, good temper, and business-like qualities which he displayed were such as to make it a matter of much regret that he had not been better known at an earlier period.

It would be an injustice to close this memoir without allusion to the kind offices rendered by Mr. Woollgar to private friends; it will suffice to say that many sought his counsel and assistance, and that he was ever ready to bestow both with judgment and kind feeling.

THOMAS GALLOWAY was born in the upper ward of Lanarkshire, February 26, 1796. His father and maternal grandfather had long been tenants of Symington farm and mill, in the parish of that name. His paternal grandfather had been noted in his district as a mechanical engineer, and in that character had been retained for some years at St. Petersburg by the Earl of Hyndford, the British ambassador. The subject of this memoir received his first education in the parish schools of Symington and Biggar, and the academy of New Lanark. His studies were mostly classical, and he obtained distinction in them. He entered the University of Edinburgh in 1812, and studied there eight sessions. In 1811 some French officers, prisoners of war, came to reside in his native district on parole. Of some of these he made the acquaintance, and finding two of them able mathematicians and willing to give instruction, he became their pupil during the months when he was not at college. Any one who knew his age could observe that he had a familiarity with, and taste for, the French school of mathematicians, such as few acquired in his day from the mathematical education given in either the Scotch or English universities. But, according to his own account, though studying mathematics with pleasure, he never felt that interest in them which determined his career until he came under the instructions of Professor Wallace in the winter of 1815–16. A prize proposed for the solution of certain problems was gained by Mr. Galloway, who thereupon became a favourite pupil of the professor. Mr. Wallace assisted him in finding employment as a teacher and as an editor. He remained at Edinburgh until 1823, took the degree of Master of Arts, and qualified himself for the church, for which he had been originally intended; but he did not apply for a preacher's license, feeling rather inclined towards the life of a teacher of science.

In 1823 he was appointed one of the teachers of mathematics at the Royal Military College, Sandhurst. In 1831 he married the eldest daughter of his old teacher, Professor Wallace. In November 1832, he became a candidate for the chair of Natural Philosophy in the University of Edinburgh, vacant by the death of Sir John Leslie, and was one of three who were selected for final consideration out of a numerous list of candidates. At the end of the following year he was likely to have been selected as professor of

astronomy in the same university; but at this time he obtained the situation of registrar (as the actuary is there called) of the Amicable Life Assurance Office, the oldest in London. In this post he continued till his death, which took place from spasms of the heart, after many months' illness, on November 1, 1851.

Mr. Galloway's publications, though numerous, were mostly, from their nature, anonymous. Perhaps the earliest was the article Pendulum, in Brewster's *Cyclopædia*. In the *Encyclopædia Britannica*, he wrote the articles Astronomy, Balance, Calendar, Chronology, Comet, Figure of the Earth,* Precession of the Equinoxes, Probability. This last article has been separately published. It gives from Laplace and Poisson a complete account of the use of the theory of probability in observation. In Leybourn's *Repository* he wrote two articles on Porisms, and a biography of Sir John Leslie. He also contributed to the *Edinburgh Review*, in which his first article was a review of the *Memoirs* of our Society (No. 101); and to the *Foreign Quarterly Review*. Many reviews were also contributed by him to the *Philosophical Magazine*. Many of these reviews are historical essays of considerable research; the account of M. Pontécoulant's work, from the *Foreign Quarterly*, was translated into French in the *Révue Encyclopédique*, tom. 46. In the *Philosophical Transactions*, part i. for 1847, he wrote an elaborate memoir on the proper motion of the solar system, derived from the proper motions of the southern stars, which was honoured by the award of the Royal medal. This memoir is an extensive calculation of probable errors; and in vol. xv. of our own *Transactions* is another research of the same kind relative to the great survey in England. To this application of the theory of probabilities his mind peculiarly inclined; and the nature of an actuary's business has a tendency to encourage attention to that subject in general. He also wrote a paper on our knowledge of shooting stars, which was printed in vol. v. of the *Monthly Notices*. In the conduct of the business of the Royal Society, he was for many years an active participator; and the loss of those nameless services, on which the progress of a society so much depends, will be felt by our neighbours as well as by us.

Mr. Galloway was elected to the Council of this Society in 1834, immediately after his permanent settlement in London. He served the office of secretary, or of foreign secretary, in six different years; and was second to none who have filled those offices in the attention which he devoted to their duties. Every matter of business was with him a matter of anxiety; and he never felt sure that it was done, or done well enough. In the conduct of our affairs he was, indeed, among our most valuable members. His habits were those of a man of business, and he had, in a remarkable degree, that power over details which enables its possessor to keep all his object in view, and to attain it all. These excellent and

* His latest writing on this subject, the article "Trigonometrical Survey," in the *Penny Cyclopædia*, is a clear and brief summary of its methods and history.

useful qualities, combined with his strict attention to enforce economy, were not only most beneficially felt at the time, but have had a very perceptible influence since. On the very last occasion on which he spoke of the Society, in a conversation with the writer of this memoir, a few days before his death, he expressed an earnest desire that neither strength nor length of eulogy should be inserted in this Report. The writer, who promised that his request should be complied with, conceives that the simplest truth, though expressed in the spirit of the promise, must defeat the intention with which it was exacted. Mr. Galloway was a mathematician to whom no terms of less force than sound and learned can be applied. He was one of the few to whom the history of exact science and its applications was familiar, especially that of the seventeenth and eighteenth centuries. He was, so far as he chose to be, a collector of books; and though his library was not large, yet no astronomical collection of equal value and rarity, for its size, has been for many years offered for sale. The collection of Kepler's works is unique, as to its completeness in any one library, being under nineteen titles. With his books he was familiar; and in his writings, so far as they are historical, it is plainly seen that he had consulted originals. The love of accuracy was a strong feature in his character. He was not, probably from want of continued opportunity, given to astronomical observation; but he had an interest in the details of it, particularly in those which relate to geodesy, and in its history, which is very seldom felt except by those whose time is or has been largely devoted to it. It was this which brought him into contact with our Society, and made him one of its steadiest supporters; and if, in deference with his dying wish, little is said of his attainments or his publications, the Council may at least express their conviction of the eminent value of his services to us, and their persuasion that his name will be long remembered among us.

The late Peter Clare, Esq., was born in Manchester, some time in the early part of the year 1781, but the exact date of his birth is not known. While quite a youth he was accustomed to assist his father, who was in the habit of giving occasional lectures on electricity and kindred subjects, illustrated by experiments. The son, in consequence of his early habits and inquiries, was frequently admitted to the meetings of the Literary and Philosophical Society of Manchester, while he was yet ineligible for membership on account of his youth. His modesty held him back till the year 1810, when he was regularly proposed and elected an ordinary member. Subsequently he was made a member of the Council. In 1821 he became secretary, which post he retained till 1842, when he was elected a vice-president of the society. He held this office during several of the latter years of his life, and discharged its duties with unremitting attention, till disabled by his last fatal illness. Mr. Clare was not a frequent contributor to the memoirs of any of the literary or scientific societies with which he was connected; but he was an ever active friend to all engaged in such

pursuits, was thoroughly imbued with a taste for philosophical investigation, and acknowledged by all who knew him to be a man of very varied and extensive information.

He was for many years the intimate friend and almost constant companion of Manchester's brightest ornament, the late celebrated Dr. John Dalton, and was appointed one of the doctor's executors. He was equally known as a zealous and untiring member of the Anti-slavery committee, and was on several deputations to the Government during the agitation of that great question.

While in health Mr. Clare was uniformly cheerful. In the social circle he was always entertaining, and not unfrequently facetious, having a large fund of humorous anecdotes and amusing narratives at command. His company was often sought and always acceptable. Like his illustrious friend Dr. Dalton, he was brought up a Quaker. To that denomination he adhered through life; but he never unseasonably obtruded his religious opinions upon others.

Mr. Clare was never married, and has left very few near relations to mourn his loss. His last illness was long, but not painful. The disease under which he finally sank is believed to have been an affection of the heart. He died on Monday, Nov. 24, 1851, in the seventy-first year of his age, and was interred on the following Sunday in the Friends' burying-ground, Mount Street, Manchester. His remains were followed to their last resting-place, by a numerous body of his own denomination, by the President, the Council, and other members of the Literary and Philosophical Society, and a large concourse of spectators.

Peter Clare was in every sense a truly respectable and much respected man, an ornament to the connexion in which he moved, and his loss is sincerely regretted by a wide circle of acquaintances and friends.

Thomas Wright Hill, a member of our Society almost from its first institution, died at Bruce Terrace, Tottenham, on the 13th of last June, in the eighty-ninth year of his age.

He was born at Kidderminster in April 1763. Even in early childhood he exhibited a strong taste for study and an insatiable appetite for books, of which he devoured all that came in his way. Amongst others of his great favourites were the *Pilgrim's Progress*, *Paradise Lost*, and Stackhouse's *History of the Bible*, in two volumes folio.

He was educated at the Grammar School of his native town, where, as usual, mathematics formed no part of the course; in common arithmetic he received instruction elsewhere. As his introduction to the study of geometry was a little curious, it is described as nearly as possible in his own words:—

"A worthy man, a friend of my father's, was appointed joint trustee with him to administer the estate of a common acquaintance who had lately died. The latter being a man of somewhat secluded habits and of a studious and philosophic turn of mind, some of the

good people of Kidderminster set him down as in league with the Evil One. This gentleman, knowing that I was fond of books and of study, had bequeathed to me two volumes, which, however, my father's friend and coadjutor very strongly recommended him to burn, without allowing me even to see them, as they bore a suspicious appearance, and came from a dangerous quarter. My father, who was somewhat less credulous than his neighbours, said, 'Oh, let the boy have them;' whereupon were put into my hands —a *Manual of Geography* and a copy of Euclid's *Elements*."

On the latter work he immediately fastened with all the delight and energy of youthful enthusiasm; and, mastering its contents, proceeded, unassisted, to algebra and the higher mathematics, especially those portions connected with astronomy, to the study of which his attention had been attracted by a lecture from James Ferguson, which it was his good fortune to attend, and which excited in him so great a love for the science, that it always remained his favourite pursuit.

On this subject, in after life, he delivered many lectures as a fellow of the Philosophical Institution of Birmingham, doing besides as much in the way of observation and calculation as his close occupation and limited means would allow; also making it a subject of school instruction, and drawing up monthly reports upon the aspect of the heavens, which were read and explained to his pupils at Hazelwood School, near Birmingham, and in later years to the pupils of Bruce Castle, Tottenham.

In the year 1835, on his retirement from active duty as an instructor, this predilection was remembered by his former pupils; and the testimonial selected by them was a large refracting telescope by Tulley, with an inscription "indicative of their veneration for his unaffected simplicity of character, and their high respect for his abilities as an instructor and his virtues as a man."

As late as October 1847, in his eighty-fifth year, he repaired with his telescope to Willingdon, near the coast of Sussex, for the purpose of observing the great eclipse of the sun, an opportunity to which he had looked forward for years, but in which he was unhappily disappointed by the cloudy state of the weather.

Even to within a month or two of his death he was occupied in framing a system of nomenclature for the stars; his object being that the name of every star should indicate approximately its declination and right ascension.

Though on many of the various subjects to which at different times he devoted his attention he could never be prevailed upon to prepare any work for the press, or even to throw the results of his investigations and reflections into a complete form, he would occasionally commit his thoughts to writing on detached points.

About ten years ago, however, he constructed, with considerable labour, a set of tables for facilitating the formation of maps on the stereographic projection, for the use of his pupils; as also a set of tables of binarian logarithms.

About fifty years ago he devised a system of short-hand writing,

which by various changes from time to time, almost to the end of his life, he at length reduced to a complete philosophical alphabet, without depriving it of its stenographic character. He has left behind him no small amount of result from his oral instruction and conversation. Much originality of thought, fertility of illustration, the observation of a long life, and the stores of a very retentive memory, rendered them attractive in a high degree. It was particularly interesting to hear him describe as matters of actual recollection events which the present generation regards as long ago consigned to the province of history. He had been familiarly acquainted with men who were enrolled for the defence of Government against the rebellion of 1745. He remembered the imprisonment of Wilkes, and of course all the great events of the American War and the French Revolution; and in dwelling upon these he generally reproduced in a racy manner the popular opinions and speculations of the respective periods.

His vivacity and love of employment continued to be marked traits in his character to within even a few weeks of his death; nor did his fondness for young persons or their attachment to him ever suffer material abatement. Long after the period of his release from his professional duties he continued to teach as an amateur; until, at the age of fourscore, by the partial failure of both sight and hearing, this practice became painfully laborious. Still his activity in pursuit of science was unabated, as in 1845, in his eighty-third year, he read at the meeting of the British Association at Cambridge a paper explanatory of a new system of arithmetical notation, in which the names of the numbers were made by virtue of arithmetical significancy given to the vowels and diphthongs to indicate their precise meaning by their structure.

His closing years he always spoke of as the happiest period of his life. Possessed of a competency according to his very moderate desires, never at a loss for occupation,

> "Studious of laborious ease
> Nor slothful,"

encompassed by his family, and seeing in the decided success and acknowledged usefulness of his sons, much more than enough to satisfy all that he had ever known of ambition; looking back with frequently expressed gratification and thankfulness on the continued course of moral and material improvement presented to him throughout his lengthened acquaintance with human affairs; his taste for literature unabated, and his relish of life almost as keen as ever, he, nevertheless, met death with the most unruffled calmness and profound resignation, full of gratitude for the past and hope for the future.

The celebrated establishment of Hazelwood, removed to Bruce Castle in 1827, with which Mr. Hill's name is much connected, and in which he gave his personal assistance, was founded, in 1819, jointly by himself and his sons, most of whom took a share in its management. The success of these gentlemen not only in educa-

tion, but in public business, is a testimony to the talent, judgment, and goodness of their common parent, which renders all other testimony superfluous. It is not usual to enumerate the sons of a deceased fellow, but in the present case he made them, and they have made themselves, a necessary part of any obituary account of him. Mr. Matthew Hill, commissioner in bankruptcy for the Bristol district, recorder of Birmingham, and late member for Hull—Mr. Edward Hill, known as the inventor of the envelope-machine, and inspector of postage-stamps—Mr. Rowland Hill, whose services as secretary to the South Australian Commission, in the foundation of that colony, must be mentioned, and whose career, as the reformer of the post-office, and the originator of the uniform penny rate, needs no mention at all—Mr. Arthur Hill, whose life has been devoted to the cause of education, in the well-known institutions above mentioned—and Mr. Frederic Hill, many years inspector of prisons, and now assistant-secretary to the Postmaster-general—all bear the testimony of their own reputation to that of their father. That father was, indeed, most fortunate, not only in the distinction gained by his sons, but in the length of life which enabled him to see the full success of their career, and to know that his share in it was, we almost venture to say, as fully appreciated by the public as it is gratefully acknowledged by themselves.

Lord Melville, the only son of Henry first Viscount Melville and Baron Duneira, was born on the 14th of March, 1771, and was educated in the High School of Edinburgh, where he generally held the third place in the rector's class, then taught by the learned Dr. Adam. The powerful influence of his father opened the path to political employment; and in the year 1802 he was returned to the House of Commons as member for the county of Edinburgh. His conduct was generally considered judicious and sound, although he does not appear to have taken any prominent share in public business, till the question of his father's impeachment in 1805 drew him frequently into debate. He successively became President of the Board of Control, and chief Secretary of Ireland; but the sudden death of his father, in May 1811, unexpectedly called him to the House of Peers.

On the formation of the Earl of Liverpool's Ministry in 1812, Lord Melville became First Lord of the Admiralty, with a seat in the Cabinet; and he continued to discharge the duties of that highly responsible office for fifteen years. He retired from office on the accession of Mr. Canning; but resumed his place at the head of the Admiralty when the Duke of Wellington came into power in January 1828, when he remained in office until the dissolution of the Ministry in November 1830. That event closed his official career, though he still took an interest in public affairs, and was of essential service in the discussion or settlement of several questions of importance to Scotland. At length he was attacked by bronchitis at the beginning of last June, which quickly assumed an alarming shape, and in ten days carried him off in his eightieth

year. He died at Melville Castle, leaving a family of four sons and two daughters.

Major-General Sir WILLIAM MORISON, K.C.B. and M.P., who died on the 15th of May, 1851, was one of the many able officers whom the East India Company's service has produced. He went to India as a cadet in 1800. From his outset in life he applied his faculties to military science, in which his attainments were such as to place him on a level with men of celebrity in the armies of Europe.

So early as 1809 he filled the office of secretary to the Military Board at Madras. At the end of 1810 he was selected by Sir George Barlow, the governor of Madras, as the most competent person to form a commissariat establishment, then new to India. In addition to these laborious duties, he undertook the superintendence of the geographical and statistical survey of the Madras territory in the years 1811 and 1812. In this occupation, so congenial to his taste and acquirements, he took much delight, and acquitted himself greatly to the public advantage.

Colonel Morison was in the field as commissary-general throughout the military operations of the Mahratta war in 1817 and 1818, and was present at the battle of Mahidpore, in which he had an opportunity of exercising his talents as an artillery officer. After having been laboriously employed for fifteen years in the formation and direction of the Madras commissariat, he was transferred, by Sir Thomas Monro, to the diplomatic department, as Resident at the Court of Travancore. He was subsequently deputed by Lord William Bentinck, the Governor-general, in conjunction with Mr. J. M. Macleod, to administer the government of Mysore. In both stations he manifested the same capacity for business and devoted regard for the interests intrusted to him as had marked his previous career.

On the change in the constitution of the Indian Government, which took place in 1834, he was the first military officer selected for a seat in the Supreme Council of India. He filled that high position for five years.

During Lord Auckland's protracted absences from the seat of Government, the still more important and elevated offices of President of the Council of India and Deputy-governor of Bengal devolved upon him. In them he bore his faculties with so much prudence and judgment as to gain general approbation and good will. He returned to England in 1840, after forty years of active service in the East, and soon after attained the rank of major-general.

For above nine years he represented his native county, Clackmannan, in Parliament, and gave a steady support to the Liberal party. He occupied himself with the study of mathematical and physical science, and to the close of his life took a lively interest in certain improvements in gunnery, and small arms of his own invention, by which he believed that the national defence might be

materially promoted. Besides our own, Sir William Morison belonged to the Royal Society and to the Royal Asiatic Society.

For his military services he was made a Companion of the Bath in 1821, and, on the extension of that order, the dignity of a Civil Knight Commander was conferred upon him. Sir William Morison's disposition was remarkably benevolent and sociable, his heart warm and kind, and he has left many attached friends to lament his loss.

The greatly increased number of small planets, all subject to perturbations of great magnitude, and all moving in orbits of such inclination and ellipticity that it is extremely difficult to reduce their perturbations to a tabular form, has led M. Encke to examine whether it is not possible to effect the special numerical calculation of the perturbations by a process easier than that commonly employed. It is known that, in the usual method, the theory commences with the measure of disturbing forces in the directions of three rectangular co-ordinates; but the subjects of the special calculation in every instance are the perturbations of the elements of the planet's orbit; and when these perturbations are found and are applied to the elements existing at the beginning of the period of calculation, the planet's heliocentric place, and finally its rectangular co-ordinates, are computed for exhibition of the geocentric place. It occurred to M. Encke that the perturbations might be so computed as to exhibit *immediately* the changes in the values of the rectangular co-ordinates. If ξ, η, ζ, are put for those changes, then the equations upon which the determination of ξ, η, ζ, depends, are three simultaneous linear differential equations of the second order, $\frac{d^2\xi}{dt^2}$ being expressed by means of ξ, η, ζ (affected with co-efficients depending on the body's position with respect to the sun), and of the disturbing forces; and similarly for η and ζ. Now M. Encke has shown that, when the disturbing forces are computed for equidistant intervals, the process of double summation (upon which the double integration of $\frac{d^2\xi}{dt^2}$ may be made to depend) can be effected without sensible error, by introducing on the right side of the equation, step by step, very approximate values of ξ, η, ζ, for each successive interval, inferred from those which are computed for the preceding intervals. And M. Encke has shown, by actual calculation, that the results thus obtained do accurately agree with those obtained by the usual method; whereas, in his estimation, the labour of computation is reduced to less than one-half. This process appears likely to be of very great importance; most useful, without doubt, for the case for which it was invented; but likely also to be extremely useful in other numerical equations depending on physical investigations which lead to impracticable differential equations.

It is well known to persons engaged in the conduct of an active

observatory, especially where there are several assistants employed in the observation of transits, that there is no greater source of annoyance and uncertainty than what is usually called the *personal equation* in the observation of transits. And this is the more annoying, because there has been reason to think that between the same individuals the amount of the personal equation is not invariable, although the circumstances upon which its value depends are not well understood. We, therefore, attach considerable importance to an invention of Mr. Thomas Jones (formerly of Charing Cross, now of Rupert Street), expressly designed for the measure of this personal equation between two observers at any given time. It consists of a trunk tube, to be inserted in the eyepiece-socket of the transit, from which trunk there branch forth two eye-tubes, inclined with each other and with the trunk at angles of about 120°, one eye-tube for each observer. The pencil of light from the object is received upon a reflecting prism, by the edge of which the pencil is divided into equal parts, and by the surfaces of which the two halves of the pencil are transmitted up the two eye-tubes. And, when the adjustments are correct, the two observers see the object and the wires which it transits with perfect distinctness; they listen to the beats of the same clock; but they record their independent observations each in his own book. It would appear that here there can be no source of uncertainty, except in some cause of constant error peculiar to each eye-piece; and the effects of such a constant error are eliminated by reversing the observers with respect to the eye-tubes. An instrument on this construction has been introduced at the Greenwich Observatory, but has not been in use long enough to furnish positive results: it appears, however, likely to give great information on personal equation and all its modifications.

The improvements made from time to time, in those contrivances of civilisation or practical science, which are intended, in the first instance, for the convenience of ordinary or commercial life, render it advantageous and even necessary for the superintendents of astronomical institutions occasionally to examine how far it may be desirable to depart from ancient practical arrangements and to adopt new ones. Thus it has become impossible to overlook the advantages which may arise to pure astronomy (in the communication of observations), to geodesy (in the determination of longitudes), and to society in general (in the dissemination of accurate time), from a galvanic connexion of our national observatory with the great system of telegraphs throughout this kingdom. Within no long time, two events have occurred which tend greatly to facilitate this connexion and to increase its possible advantages. The first is, the establishment of a line of telegraph along the North Kent Railway, which passes within little more than a mile of the Greenwich Observatory. The second is, the successful establishment of the submarine telegraph, which gives the power of extending a connexion once made with the telegraph of the South-

Eastern Railway to France, and to almost every part of Europe. It is, therefore, with great satisfaction we announce that, on the representation of the Astronomer Royal, the Lords Commissioners of the Admiralty have sanctioned the galvanic connexion of the Royal Observatory with the North Kent Railway; and that measures are actually in progress, at the present time, for making this connexion. The wires will be carried underground across Greenwich Park and Blackheath to the Lewisham station, thence they will be conducted along the line of railway to the London bridge terminus, and there facilities will be given for the connexion of these wires with the Dover wires (by which the communication with the Continent will be made), and with the wires of the Electric Telegraph Company (by which communication will be made with the British observatories, and also with stations and public clocks, to which it is desirable to transmit signals of accurate Greenwich time). It is impossible to speak too highly of the liberality which has been displayed by the corporate bodies (the South-Eastern Railway Company and the Electric Telegraph Company), whose assistance was requisite for carrying out this project. MM. Arago and Babinet, and the members of the Bureau des Longitudes and the Institut, have shown the greatest interest in the completion of the connexion between Paris and Greenwich; and already a plan of observations has been in part concerted; to be directed in the first instance to the determination of the difference of longitude of the two observatories.

The new transit-circle of the Royal Observatory has been so repeatedly brought before the notice of the Society that it appears wrong to occupy their time with any detailed allusion to it at present. Still it appears proper to state that, after more than a year's experience (during which period this instrument has borne the entire charge of the meridional observations), there remains no doubt in the mind either of the Astronomer Royal or of the astronomers more immediately engaged in making and reducing the observations, that no other instrument with which they are acquainted can be compared with this for the steadiness and accuracy of adjustments and for the accuracy of results. It is unnecessary to allude to its great optical power, as the securing of this was in fact the first condition which required the construction of a new instrument on a novel plan.

The reflex zenith tube of the Royal Observatory was brought into use for the observations of γ *Draconis*, in the autumn of last year; and the observations, in consequence, have for the most part been made by daylight. This circumstance makes it difficult at present to state precisely the success of the construction. Several observations have been made, apparently of the most accurate kind; several have failed, the star not being visible. It is at present doubtful whether this arises from the tremor of the quicksilver (the pencil of light being in every case reflected from the surface of quicksilver), or from any other cause. It seems not improbable

that it may be found necessary to change the site of the instrument for one less affected by external disturbances.

During the last year the Radcliffe Trustees have increased the personal establishment of their Observatory by another assistant. Mr. Pogson has been appointed, whose name is well known to the Society. The Trustees have also sanctioned the employment of a computer. With this additional help Mr. Johnson hopes to be able to continue the meridian observations as heretofore, and to devote his own attention to the heliometer.

Little has been done with the latter instrument since the last Report, all the force of the establishment having been required to complete the circumpolar catalogue. The observations for this work may now be considered finished, and much has been done in arranging them to form a catalogue. This task has been consigned to Mr. Luff of Oxford, who is well qualified for it from his long familiarity with the Radcliffe Observations.

The next work to which Mr. Johnson proposes to apply the meridian instruments of this Observatory, is the revision of Piazzi's Catalogue as far as 110° of north polar distance. Stars south of that limit he proposes to leave to observatories better situated for observing them.

At Cambridge, Professor Challis is proceeding on the plan mentioned in our last Report, and is advancing in the publication of past observations. The meridian observations of 1846 are nearly printed, but vol. xvii. of the *Cambridge Observations* will not appear for a considerable time, as it is intended to include those of 1847 and perhaps of 1848. Changes are making in the apparatus of the Northumberland equatoreal, by which it is hoped to measure differences of right ascension (the clock carrying the instrument), yet more satisfactorily than hitherto. It is worthy of note that Faye's comet, on its first return in 1850, was observed at Cambridge nearly five weeks before it was seen at any other observatory, and the observations were continued till March 4 of last year. These observations are valuable, both for their extent in time, and also because the number of observations of this comet elsewhere, during the return in question, was not considerable. Great credit is deservedly given by the Observatory Syndicate to MM. Breen and Todd, the assistants at the observatory, for the manner in which these observations were secured under circumstances of unusual difficulty.

The effective advance of a practical and working observatory with a limited staff, is rather to be judged of by the calculations and printing, than by the number of observations obtained; and, in this point of view, it is gratifying to hear that the printing of another volume has just been concluded at Edinburgh, containing the calculated observations made there from 1844–1848; and further,

that the calculations for 1849, 1850, and 1851, are so far advanced; that the good effect of the solid, unadjustable Y bearings, and other improvements applied to the transit instrument, can now be spoken of with certainty. The fluctuations of the axis in azimuth, which used to amount to above the large quantity of a second of time, and that with a degree of suddenness and capriciousness which defied calculation, are now reduced to within $\frac{1}{4}$ of the former amount in quantity; while there is even a greater improvement in the manner. The changes are much slower and more regular than before, and are such as may not improbably be owing to differences of expansion in the stone composing the piers: they can, too, be effectually checked by the increased means now at command for examining, under all circumstances, the position of the instrument.

In having thus passed beyond the period of his late lamented predecessor's term of office, in the calculation and printing of the observations in the old-established form, Professor Piazzi Smyth has by no means forgotten the importance of publishing a resumé of the whole of Professor Henderson's work, more especially of condensing all the separate annual lists of stars into one general catalogue. But while this would prove a long work, with his time so much occupied at present by the lectureship attached to the office; and while it was manifestly of great importance, also, to bring up the calculations, and all the book-keeping of the stars to the present time, so as to be more free from actual work, and for making those observations which are now expected from Edinburgh,—yet, as the subject of procuring a second assistant for the establishment has been taken up by the Board of Visitors, he trusts that the commencement of the general catalogue has only been deferred a short time, and that, when begun, it will be quickly carried through.

At the observatory of Durham, Mr. Carrington has been engaged during the past year on the small planets and comets with the equatoreal: the observations have appeared in our *Notices*. An interruption of seven weeks occurred in the spring, in consequence of an attack of inflammation of the eye, induced by over-exertion of the retina; and during the greater part of July, Mr. Carrington was absent in Sweden, for the purpose of observing the eclipse of the sun: with those exceptions the small planets have been kept constantly in view. No change of instruments has taken place. Mr. Carrington has resigned the charge of that observatory, and will leave Durham in April next. It is to be hoped that an observer so zealous, intelligent, and methodical, will not be lost to astronomy.

Of the Liverpool observatory nothing new need be said; it maintains its reputation as the most trustworthy authority for *extra-meridional* observations, for *immediate* use. The excellence of his equatoreal enables Mr. Hartnup to compare all his objects with one or more perfectly well-determined stars, so that he obtains at *once* what an observer less completely equipped (that is, almost *every other observer*) may wait months to obtain. The reader of

the *Monthly Notices*, who can translate the data before him, has only to run his eye over the Liverpool observations, to feel convinced that what is here stated is a simple fact. Besides the care of testing and rating chronometers, which must in time have a most beneficial influence on navigation, though its progress is slow, Mr. Hartnup has lately been charged with the duty of taking very extended meteorological observations, at the request of the registrar-general, of which a specimen has been sent to us. We are rejoiced to find researches and observations of so useful a nature in such good hands; but we trust that Mr. Hartnup's patrons will not forget that there are limits to what a man can do, and that, after having gained the applause of the astronomical world for the liberality and judgment with which they planned and furnished their observatory, and after the striking success by which it has been attended, it would be bad economy to divert the principal attention of their astronomer from astronomy. With a little additional assistance, the Liverpool observatory will satisfy both objects perfectly: but the purposes for which the observatory was founded are still far the most important in a scientific point of view to which it can be applied.

An account of the operations at Mr. Cooper's observatory at Markree Castle, for the past year, was given in the December *Notice:* the catalogue of 14,888 stars, near the ecliptic, has been printed at the expense of the Government, on the recommendation of the Royal Society. Copies of this valuable work have been presented to astronomers with great liberality, and it will be particularly acceptable to those who are searching for fresh members of our system. This is the primary object of the catalogue. Another object which Mr. Cooper had in view, was the obtaining "an increased number of points from whence, by ocular triangulation, stars to the 12th magnitude inclusive might be, with sufficient accuracy, interpolated in maps prepared for the purpose."

The large equatoreal at Markree (25 feet focal length, and 14 inches aperture), fitted with a square-bar micrometer of Mr. Graham's contrivance, and an eye-piece magnifying about 80 times, has been used for these researches. The probable errors are about $0^{s}\cdot3$ in R.A., and $4''$ in Declination. This is more than sufficient, and the convenience of the apparatus may be judged of by this: on each of two nights more than 500 stars were determined. The observations were made by Mr. Cooper and Mr. Graham; the mode of registering and reducing the observations is very clearly set forth in the preface to the catalogue. The charts in progress are on a linear scale of four times the Berlin maps. The magnitudes are readily distinguished by the mode of figuring adopted by Mr. Graham.

Though the matter is not yet arrived at maturity the Council cannot deny themselves the pleasure of recording a munificent proposal on the part of one of our Fellows, Mr. Henry Lawson, of Bath. This gentleman has offered to give his astronomical and

meteorological instruments to any individual or body of men, who will produce a sum of money sufficient to found an observatory, and to endow a resident observer with not less than 200*l.* a-year; and he has further offered to contribute one thousand guineas towards the necessary fund. The corporation of Nottingham has resolved to attempt the fulfilment of the condition, and a public meeting was held in that town on the 13th of January, at which a thousand pounds was subscribed. On the 26th it was reported that 2100*l.* had been obtained.* The sum required is estimated at 10,000*l.*; and the Council trust that it will be speedily raised, and that the institution will have an effect upon the promotion of astronomy, worthy of the high motives of its originator and benefactor.

There is not much to be said with respect to the standard yard in addition to what was stated in the last Annual Report. During the preceding summer, Mr. Sheepshanks' eyes were so weak, that he found it imprudent to attempt any measures. This would have induced him to resign his commission, if it had been easy to supply his place. It was the difficulty of finding a trustworthy person to undertake a laborious, dirty, uninteresting, and unpaid duty, which induced Mr. Sheepshanks to volunteer his services at first; and this difficulty, so far as he knows, is as great as ever. But in addition to this consideration, the course of the experiments has shown, that, next to good faith, the *identity* of the observer is the most important requisite; and that a large mass of good observations must be rejected, if a new observer were introduced, or else a discrepancy would probably be introduced of a sensible amount. Since that time, however, a considerable number of bars has been compared by Mr. Sheepshanks and by Mr. W. Simms, Jun., *with the heads of the micrometers turned the same way.* The measured length, therefore, is the *difference* of two readings, and, consequently, if an observer bisected all divisions alike, the *measures* should agree; of course, the *comparisons* should agree in every position of the micrometer heads. The measures do *not* agree, and, by a piece of ill luck, the bar adopted as the term of comparison, Bronze 28, is one about which the observers seem to differ most. The extreme difference between the results of the two observers, with respect to any bar, when the comparisons are made with Bronze 28, is very nearly one division of the micrometer, or 0·000036 inches. As this difference is made up of four bisections, it seems not unlikely that the observers might differ more than 0·00001 inch in a bisection, *i. e.* after allowing for the tendency to too *full*, or too *short*, a bisection, which disappears in a *measure.* The probable error of a set of 80 measures made by Mr. Sheepshanks, or of 20 measures by Mr. W. Simms, Jun., is scarcely more than $\frac{1}{8}$ or $\frac{1}{10}$ of the difference which is thus actually found to exist between their results, in extreme cases.

* At the time of printing this report, the sum raised amounts to 2630*l.*, not including Mr. Lawson's proposed donation.

The foregoing statement seems to show that the accuracy to be attained by a measure defined by lines or dots, or by a *divided scale*, is much less than was supposed: it shows, besides, the propriety, where great exactness is required, of performing the operation of measurement, as much as possible, by the same person, if indeed the *same* person continues to preserve his *identity* as an *observer*.

All the bronze bars, or, as they are called, "Baily's metal," would have been measured and defined by this time, but for a second attack of weakness in the eyes of the experimenter. Subject to the doubt and uncertainty mentioned above, there are no known difficulties in the execution of the rest of the task; and it is hoped that the observations, which have been resumed, may be speedily brought to a conclusion, so far at least as the present observer is concerned.

An account was given in the November *Notice* of this session of the mode in which the thermometers, used in the standard measures, were graduated. Temperature has never caused the slightest difficulty with respect to the measurement of the bars, though there is reason to suspect that the micrometers, or the screws which adjust the trough, may waver a little. The effect on the results would not however be sensible.

The year 1851 has witnessed the discovery of two new planets, belonging to the extraordinary group between *Mars* and *Jupiter*, which now numbers fifteen members. The first was found by Mr. Hind, at Mr. Bishop's Observatory, on the 19th of May, and four days later by Dr. de Gasparis, at the Royal Observatory, Naples. It resembled a star of the ninth magnitude, with a bluish light and some degree of nebulosity round it, under the most favourable glimpses on very clear nights. The planet received the name *Irene* on the suggestion of Sir John Herschel. It was observed at Washington, U.S., until the end of October, and the elements have been pretty exactly determined by several German astronomers. The period of revolution is 1515 days.

The second planet was detected by Dr. de Gasparis on the night of July 29th, in the course of his zone observations commenced with an especial view to the discovery of new planets. It was described as a fine star of the ninth magnitude; but owing to the lowness of its position (being near the ecliptic in 18^h R.A.) it was not so generally observed during its first apparition as some of the other newly discovered bodies. Dr. Gasparis called his planet *Eunomia*; the period of revolution is 1574 days, or about two months longer than that of *Irene*.

During the past year we have to record the reappearance of Encke's periodical comet and also the discovery of three new ones. The first was detected on the 27th of June by our associate Dr. d'Arrest, who speedily ascertained that no parabolic orbit will represent the observations, but that the comet is describing an elliptic orbit with a revolution of only six years. It was always

faint, and was observed with difficulty till the beginning of October. It has been conjectured that this may be the same comet that was observed in the summer of the year 1819, for which Prof. Encke calculated an ellipse.

The second comet of 1851 was found at the Observatory of Baron Senftenberg, in Bohemia, on the 1st of August, by Mr. Brorsen. The parabola agrees very well with the observations, which were continued till November.

The third comet was also discovered by Mr. Brorsen on the evening of October 22d, when it presented a rather brilliant appearance with a double tail, the shorter branch turned towards the sun. It became faint, however, before the end of the month, and was seen with difficulty in the middle of November. There are no indications of ellipticity in the orbit. This is the fifth comet which has been found by Mr. Brorsen during the last six years.

One of the most remarkable discoveries recorded during our past session is that of a dark interior ring of *Saturn*, which was first *certainly* seen by Mr. Bond at Cambridge, Massachussetts, on November 15, 1850, though he had suspected it before. This ring was seen by Mr. Dawes on November 29, before he could have received any intimation of Mr. Bond's discovery, and some days later by Mr. Lassell, with Mr. Dawes' telescope, also before he knew that it had been seen elsewhere. The dark ring has since been seen by many observers; by Mr. Lassell with his reflector, and by Mr. Hartnup with his achromatic, by Mr. Hind, Mr. De la Rue, and Mr. Fletcher. Mr. Lassell has had a drawing on a considerable scale lithographed, and Mr. Dawes and Mr. De la Rue have presented very satisfactory drawings to the Society, which are now hung up in the apartments. It is rumoured that some scepticism has been shown on the continent with respect to the reality of Mr. Bond's discovery; but from the evidence before us its existence seems as *certain*, though not so *evident*, as that of the other rings. It would seem from Mr. Dawes' remarks rather surprising that the dark ring was not seen before, or at least that it had not been inferred from the appearances which were seen.

Mr. Lassell has succeeded in bringing his reflecting telescope to so high a state of perfection that he scarcely hopes to make any important improvement in its defining powers. With this magnificent instrument he has been able to detect two interior satellites of *Uranus*, and to determine their periodic times with considerable certainty. These periodic times differ so much from the revolutions assigned by Sir W. Herschel to the two faint satellites of his discovery, that we must conclude them to be different bodies, if Sir William's determinations are deemed to rest upon satisfactory grounds. These objects are so very faint and minute that they can only be seen under favourable circumstances; but the series already observed by Mr. Lassell scarcely admit of any solution, but that

which he has arrived at, viz. that the periodic times are 2·5 and 4 days respectively.

Mr. Lassell has made a considerable set of observations of the brighter satellites of *Uranus*, those denoted by Sir William Herschel as II. and IV.; of the satellite of *Neptune;* and the fainter satellites of *Saturn.*

The Council allude to a publication which has recently appeared in private circulation, not only on account of its interest to Fellows of this Society, but because a reference to its astronomical observations may hereafter be useful to those who would think such a work unlikely to contain them. Towards the end of last year, Captain Smyth published, in a handsome quarto volume,* a description and history of the mansion at Hartwell, the residence of our late Treasurer, Dr. Lee, to whom the Society is in so many ways a debtor. This volume contains, among many other things, a full description of the Hartwell Observatory, the meridional observations made by the late Mr. Epps, those of double stars made by Capt. Smyth himself, with an historical account of γ *Virginis*, and the appearance of Encke's comet in 1848. Dr. Lee has thus connected the history of his own family with that of astronomy; and the Council hope that, at a distant period, his successors will feel the force of his example, and the wisdom of his course.

Very recently, another volume has been published more exclusively devoted to astronomy, by our Treasurer, Mr. Bishop. It is a detail of the observations made at the South Villa Observatory from its establishment in 1839 to 1851, with such historical and descriptive additions as would naturally be looked for. It contains the valuable series of double-star observations made by Mr. Dawes, and continued by Mr. Hind, together with the accounts of the four small planets, the comets, and the variable star in *Ophiuchus*, by which Mr. Hind has rendered this small observatory so conspicuous in the astronomical world. The plan pursued by Mr. Bishop is one which must have led to success, maintained, as it has been, with steadiness and unity of purpose; and the results, striking as they may appear to us, are much more remarkable elsewhere. It is never related without a feeling of astonishment that the private observatory of a London manufacturer produces those results which nothing less than the power and means of governments can attempt in any other part of Europe. The Society may well offer its hearty congratulations to Mr. Bishop, and express its hope that his example may never want imitation, both in astronomy and in every other branch of knowledge.

It will be naturally expected that, in our report on the astro-

* "Ædes Hartwellianæ; or, Notices of the Manor and Mansion of Hartwell. By Capt. W. H. Smyth, R.N. London: Printed for Private Circulation." London, 1851. 4to.

nomical events of the past year, some mention should be made of the great solar eclipse which occurred in July last. We feel it incumbent on us, in the first place, to offer something like an apology for the delay which has occurred in the publication of the observations of that phenomenon which have been presented to this Society. But, in fact, the best apology which the Committee, appointed to examine the observations and to decide upon the mode of publication of them, can give to the meeting is the large mass of matter which has been presented to them for scrutiny, and the necessity for caution in the analysis and publication of the materials collected for explanation of the wonderful phenomena which have been witnessed in the course of the eclipse. We may state that the greater part of the labour has been satisfactorily accomplished; the cuts are in the hands of the engraver; the printing is going on; and the members will soon be put in possession of the results of all the observations which have reached the Society. The *Monthly Notice* for January last contains an abstract of the purely astronomical matter.

In the few remarks which we feel it proper to make on the general results of the observations of foreign and English observers, we cannot avoid mention of the number and completeness of the expeditions which were despatched from our own shores and from various parts of the continents of Europe and America, for the purpose of observing the eclipse. Private individuals and public establishments have vied with each other in their zeal for extracting from this rare phenomenon all the information which it can afford of the constitution of the sun and moon, and for determining on more certain data some of those vexed questions which observations of former total eclipses left for astronomers to settle. Some idea may be formed of the number of observers by the fact that the *Astronomische Nachrichten* contains at least sixteen accounts given by astronomers of reputation placed at different stations on the line of totality; our own transactions will contain at least an equal number; and there are still distinct accounts to be added, such as those of Mr. Carrington, Mr. Adie, and Dr. Von Feilitsch, which have been published in separate pamphlets.

The objects of inquiry were very distinctly stated in the "Suggestions" circulated previously to the eclipse. Neglecting the purely optical and meteorological questions which were to be answered, the points of general interest related to the phenomena of Baily's beads; the corona or ring of faint light always seen in a total eclipse; and the nature and origin of the rose-coloured prominences which had been seen during the eclipse of 1842, and, though not so distinctly, in some previous eclipses. With regard to the *beads*, which were, on the whole, considered to be an optical phenomenon, and probably connected with "irradiation," the object was to try the effect under as many different circumstances as possible, and with as many different telescopes: with regard to the *corona*, it was asked whether it was concentric with and had its origin in the sun or the moon; whether its light has any clear law

of diminution in going from the borders of the discs; whether it was fixed and steady or of an undulating character, with other particulars of the same general nature. Lastly, with regard to the red prominences, it was asked whether they belonged to the sun or the moon; and, supposing the former, whether they were solid bodies attached to his surface, or gaseous, cloud-like substances suspended in his exterior atmosphere and at ordinary times invisible.

Now, as we might have expected, some of these questions have been satisfactorily answered by means of the complete organisation of observers and instructions previously arranged; while others have been left unanswered, and, indeed, over some an additional degree of obscurity has been thrown by the knowledge we have acquired.

By comparing accounts of different observers, it would seem that the formation of the beads is dependent in a great degree on the telescope employed, since some observers saw no trace of them, while others saw them under that form in which they might easily be attributable to irradiation. Thus Mr. Airy and M. Mauvais saw nothing in the breaking up of the minute crescent of the sun's light but the interruptions caused by the plainly serrated limb of the moon. Mr. Hind had the same impression, but conceived that the effect was greatly heightened by irradiation, while Mr. Dawes saw them break through the crescent while it appeared to be considerably larger than their own projection beyond the moon's circumference, thus acquiring the appearance of narrow black threads extending to the exterior edge of the sun. The latter gentleman, from what he saw, seems to have no hesitation in referring the phenomenon to irradiation.

Thus, though the question of the beads does not yet seem to be quite settled, it is reduced within narrower limits, and Professor Powell's theory is, on the whole, confirmed by the observations.

The observations of the corona seem, on the whole, to prove that it belongs to the sun. Mr. Dawes thought he saw it both brightest and broadest at the part where the sun disappeared; and, throughout the duration of darkness, it was decidedly brighter at the southern edge of the moon than at the northern: these observations, considering his local position, are in accordance with the fact of the corona being concentric with the sun. Other observers could not at all determine whether it was concentric with the sun or with the moon. Other questions relating to the corona were satisfactorily answered; its light had a gradual diminution from the surface of the sun, and certainly did not consist of annuli of uniform brightness; large bushes or bands of light diverged at nearly equal intervals around the disc; finally, it was certainly strong enough to render it visible a very few seconds before the complete disappearance and after the first reappearance of the sun.

With regard to the red protuberances, the questions asked in the "Suggestions" have been many of them satisfactorily answered; the identity of several of them seen by different observers is un-

questionable; their positions on the limb are marked down with quite as great accuracy as could have been expected; and in general the drawings of their shapes agree pretty well. The northernmost observers saw protuberances on the northern limb hidden from those placed to the south of them, and those near the southern boundary saw protuberances hidden from more northerly observers. Again, it is most decisively proved from the observations that these wonderful phenomena belong to the sun: those that were observed on the eastern limb became quickly hidden, while others sprang up on the western limb; that is, they were respectively covered and revealed on the eastern and western limbs of the sun by the advancing moon. Those also that were *immediately* seen on the western limb increased in height during the totality. Finally, one at least was seen suspended, as it were, above the sun's disc, having no connexion whatever with the limb. Thus far the results of the observations were as satisfactory as could be desired, but there are discrepancies in the accounts concerning the most remarkable of the red prominences, which cannot be referred to error of observation, and which leave greater difficulty than ever concerning the true explanation of the phenomena. On the western limb was a remarkable red protuberance, which was considerably brighter than any of the others, and was itself attended by a small red mass not in contact with the limb. Now there are scarcely two observers who agree in their description of these: they differ in their accounts of the shape of the large protuberance, but still more in their description of the small one. Mr. Airy describes the large one as in shape like a bomerang, and in his drawing it consists of two arms very nearly at right angles to each other. Mr. Dawes is also very clear in his description of its shape and colour, and represents it as in shape resembling a Turkish cimeter, bent rather suddenly at the apex. Others describe it as of a sickle-shape, with the top broken off. The drawings differ quite as much as the verbal descriptions. The differences in the accounts of the accompanying mass are still greater. Mr. Airy saw it well defined at the borders, and in shape resembling a balloon. Mr. Dawes saw it like the top of a conical mountain, with its base cut off by mist. Others saw nothing but a spider-like irregular mass. Some saw distinctly arches of light, connecting it with the large prominence, which were not seen at all by others. Nor did these differences depend upon distance of locality. Lieut. Pettersson, located at two miles distance from Mr. Airy, differs considerably from Mr. Airy in his account. The appearances seen by MM. Lassell, Williams, and Stanistreet, who observed in the same house, are not the more accordant on that account. It seems, indeed, on the whole, impossible to reconcile the statements, without some hypothesis of *mirage*-effect, or other modifying cause, existing either in the neighbourhood of the moon, or in our own atmosphere.

Next to the large prominence, or perhaps superior to it in interest, are the *deep red sierras*, or jagged mountain-chains seen by

most of the observers, consisting of a succession of scarlet-coloured prominences, united at the base by a continuous red band. With regard to this phenomenon, Mr. Airy saw the most magnificent display of a probable effect of it. Along the north horizon, to about 30° or 35° of altitude, the sky was illuminated with rosy-red light for a breadth of about 90° in azimuth. At this time, the sierra which he saw in the telescope was far more brilliant in colour than any of the detached prominences; and it suggests the only probable or satisfactory explanation of the light.

On the whole, we may congratulate the Society on the success which attended the greater number of the observing expeditions;—many doubtful circumstances have been cleared up; and with regard to those which remain still perplexed and mysterious, we have data for the guidance of future inquirers, which will probably help at some future time to elicit materials for a far more minute acquaintance with the constitution of the sun than we at present possess.

At one of our late evening meetings, an instance was afforded of the aid which the art of drawing affords to practical astronomy, by the exhibition of a series of six large coloured landscapes by Professor Piazzi Smyth. These were drawn during the solar eclipse of last July, on the island of Bue on the coast of Norway, just within the band of totality.

In this instance the weather was adverse to astronomical observation; but the vicissitudes of the atmospherical effect during the progress of the phenomenon are very strikingly shown in the views which were exhibited, not only in the foreground, but also on the distant snow-capped mountains; and the very singular variations of sky, from the commencement of obscuration, through the totality, to the eclipse passing off, were faithfully represented. In these views, the peculiar streams, as it were, of clouds descending towards the sun, the dense crimson of one portion, the brilliant yellow of another, and the lurid aspect of the deepest darkness, offer much matter for physical inquiry.

Papers read before the Society from February 1851 to February 1852.

1851.

Mar. 14. Observations of Faye's Comet. Prof. Bond.
Ephemeris of *Egeria*. M. G. Rümker.
Observations of *Victoria*, &c. Mr. Carrington.
Elements of *Egeria*, and Notice of *Saturn*. Sig. Secchi.
Observations of *Victoria*. Mr. Hartnup.
Observations of *Victoria*. Mr. Graham.
Elements of Victoria. Dr. Gould.

Ephemeris of *Victoria.* M. Villarceau.
Graphical Solution of the Orbit of a Planet. M. Villarceau.
Notice of Lecture, Jan. 10, 1851. Sir J. Lubbock.
Observations of *Egeria.* Mr. Carrington.
Observations of *Metis.* Mr. Hartnup.
Ephemeris of *Egeria.* M. G. Rümker.
Observations of *Egeria.* M. C. Rümker.
On supposed Self-luminous Bodies. Mr. Jeans.
Azimuths on a Spheroid. Lieutenant Clarke.
On the Correction of the Altitude of the Pole Star. Mr. J. Riddle.
On the Parallax of α^1 and α^2 *Centauri.* Mr. Maclear.
On a Modification of the Quadrant. Mr. Hedgecock.
Observations of Small Planets. Mr. Hartnup.
Transits of Standard Stars. Rev. A. Weld.

Apr. 11. Note to *Monthly Notices*, Vol. ix. p. 184. Mr. Airy.
On Zodiacal Light. Mr. Lowe.
Note on his Drawing of *Saturn.* Rev. W. R. Dawes.
On the Correction of Lindenau's Elements of *Mars.* Mr. H. Breen.
On the Determination of the probable Stability of an Azimuthal Circle. Mr. Airy.
On the Elements of the Binary Star γ *Virginis.* Mr. Hind.

May 9. On the Vibration of a Free Pendulum in an Oval differing little from a Straight Line. Mr. Airy.
Elements and Ephemeris of Biela's Comet, 1852. Professor Santini.
Observations of *Metis.* Mr. Hartnup.
On the Use of the Gregorian Calendar for ascertaining New and Full Moon. Mr. De Morgan.

June 13. On the Discovery of *Irene.* Mr. Hind.
On a Solar Spot. Rev. A. Weld.
On the Nature of Solar Light. Mr. Nasmyth.
On the American Mode of Observing by the Galvanic Current. Mr. G. P. Bond.
Observations of *Irene.* Mr. Carrington.
Notice of Improvement in the Supports of Specula. Mr. Lassell.
Ephemeris of *Irene.* Mr. Pogson.
Observations of Faye's Comet and of *Irene.* Professor Challis.
Measurement of γ *Virginis.* Mr. Fletcher.
Occultation of Fixed Stars by *Jupiter.* Rev. W. R. Dawes.
Observations of *Irene* and *Astrea.* Mr. Hartnup.
Meridian Observations of *Irene.* Mr. Airy.
On M. Foucault's Pendulum Experiment. Mr. Drew.
Observations of *Jupiter's* Satellites. Mr. Moyes.
Observations of Minor Planets. Mr. Carrington.

Observations and Ephemeris of *Irene*, *Astrea*, &c. M. Rümker.
Elements of *Irene*. MM. Vogel and G. Rümker.
Remarks on Dr. Galle's Observations of Dark Ring of *Saturn*. Rev. W. R. Dawes.
On the Observation of Solar Spots with large Telescopes. Rev. W. R. Dawes.
On the Determination of a Meridian Point. Rev. A. Weld.
Observations of *Irene*. M. Rümker.
On the Discovery of *Irene*. Mr. Hind.
On the Solar Eclipse, Feb. 1, 1851. Mr. Clarke.
Nov. 14. Observations of *Irene*. Mr. Carrington.
Elements of *Irene*. M. Fergola.
Elements of *Irene*. Mr. Carrington.
Observations of *Hebe*. Mr. Carrington.
Observations of *Irene*. The Astronomer Royal.
Observations on Foucault's Pendulum Experiment. M. Secchi.
Elements and Ephemeris of *Irene*. Mr. Pogson.
Circular, D'Arrest's Comet. Dr. Petersen.
Observations of *Irene* and *Hebe*. Mr. Hartnup.
Ephemeris of *Parthenope*. M. Luther.
Observations of *Irene*. Mr. Boreham.
Observations of *Irene*. M. Rümker.
On Reflecting Instruments. Professor C. P. Smyth.
Planetary Observations. M. Rümker.
Planetary and Cometary Observations. MM. C. and G. Rümker.
Notice of Discovery of *Eunomia*. Dr. Petersen.
Observations and Elements of *Eunomia*. Dr. Petersen.
Discovery of Brorsen's Comet. Dr. Petersen.
Discovery of D'Arrest's Second Comet. Dr. Petersen.
Elements of D'Arrest's Second Comet. M. Vogel.
Elliptic Elements of D'Arrest's Second Comet. Mr. Pogson.
Moon-culminations at Hamburgh. M. Rümker.
Observations of *Hebe*. M. Rümker.
Observations, &c., of *Eunomia*. M. Rümker.
Elements and Ephemeris of *Irene*. M. G. Rümker.
Observations of *Jupiter* and his Satellites. Rev. J. Slatter.
Elements and Ephemeris of *Parthenope*. M. Luther.
Observations of Planets and Comets. Professor Challis.
Observations of Planets and Comets. Mr. Carrington.
Ephemeris of *Egeria*. M. G. Rümker.
On the Orbit of γ *Virginis*. Mr. Fletcher.
On the Dark Ring of *Saturn*. Mr. Hartnup.
Planetary, &c., Observations. Mr. Hartnup.
Discovery of Satellites of *Uranus*. Mr. Lassell.

On an Improvement on the Quadrant. Mr. Hedgecock.
On the Solar Eclipse, Jan. 31, 1851. Capt. King.
Occultations, &c., and on the rule for equal Altitudes. Capt. Shadwell.
Ephemeris of *Parthenope.* MM. Luther and Vogel.
On Discordance of observed Places of Stars with B.A.C. Mr. Maclear.
De la Determination des Orbites Elliptiques. M. Valz.
On Hind's Third Planet. M. Villarceau.
Elliptic Elements of D'Arrest's Comet. The Astronomer Royal.
On the Rings of *Saturn.* Mr. De la Rue.
Observations of *Saturn.* Mr. Lassell.
On the Rings of *Saturn.* Mr. Fletcher.
On the Solar Spots. Mr. Miller.
On the Solar Spots. Capt. Shea.
On the Solar Eclipse, July 28, 1851. Mr. Snow.
Ditto ditto Mr. Lassell.
Ditto ditto Mr. Stanistreet.
Ditto ditto Mr. Williams.
Ditto ditto Mr. Miller.
Ditto ditto Rev. T. Chevallier.
On the Satellites of *Uranus.* Mr. Lassell.
On the Solar Eclipse, July 28, 1851. Rev. W. R. Dawes.
Dec. 12. On Luminous Bodies seen in Daylight. Rev. W. Read.
Cosmical Speculations. Mr. Dempster.
Observations. Mr. Boreham.
Observations. Mr. Hartnup.
Ephemeris of Brorsen's Comet, &c. M. Rümker.
Circular, Brorsen's Comet. Dr. Petersen.
Ephemeris of D'Arrest's Comet. Mr. Pogson.
Occultations of Stars. Mr. Snow.
Third List of Stars in B.A.C. Corrections in R.A. Lord Wrottesley.
On the Satellites of *Uranus.* Mr. Lassell.
Observations of *Saturn,* &c. Rev. W. R. Dawes.
Note on Mr. Slatter's Paper, No. 188. Rev. W. R. Dawes.
Solar Eclipse. Measurement of Solar Spots. Mr. Pogson.
Solar Eclipse, July 28, 1851. Mr. Hind.
Ditto ditto Professor C. P. Smyth.
Ditto ditto The Astronomer Royal.
Ditto ditto Mr. Dunkin.
Ditto ditto Mr. Humphreys.
Ditto ditto Capt. Biddulph.
Ditto ditto Capt. Blackwood.
Ditto ditto Mr. Gray.
Ditto ditto Lieut. Krag.
Ditto ditto Mr. Jackson.

Solar Eclipse, July 28, 1851.		Colonel Silverstolpe.
Ditto	ditto	Mr. Stephenson.
Ditto	ditto	Lieut. Pettersson.
Ditto	ditto	Mr. Young.

On the Adjustment of a Transit Circle and an Equatoreal. Mr. Drew.

Observations of Solar Spots. Mr. Turnbull.

1852.
Jan. 9. Notice of Rümker's Observations of De Gasparis' supposed Planet. Professor Challis.

Observations of *Parthenope, Pallas,* and *Victoria.* Mr. Carrington.

On De Gasparis' supposed Discovery of a new Planet. Dr. Petersen.

On the Markree Ecliptic Catalogue. Mr. Graham.

List of Public Institutions and of Persons who have contributed to the Society's Library, &c. since the last Anniversary.

Her Majesty's Government.
Royal Society of London.
Royal Society of Edinburgh.
Royal Irish Academy.
Royal Geographical Society.
Royal Asiatic Society.
Royal Institution.
The Board of Admiralty.
Geological Society.
Cambridge Philosophical Society.
Linnean Society.
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Address delivered by the President, J. C. Adams, Esq., M.A., Fellow and Tutor of St. John's College, Cambridge, on presenting the Gold Medal of the Society to M. Peters.

It has already been announced to you that the medal of the Society has been awarded to M. Peters, for his two papers, entitled, "Numerus Constans Nutationis ex Ascensionibus Rectis Stellæ Polaris in Specula Dorpatensi Annis 1822 ad 1838 observatis deductus," and "Recherches sur la Parallaxe des Etoiles Fixes," which are published respectively in the third and fifth volumes of the sixth series of the *Mathematical and Physical Transactions of the Imperial Academy of Sciences of St. Petersburg;* and it is now my duty to explain to you the grounds of this award, which (unless their effect be marred by my very imperfect statement of them) will, I doubt not, secure your approval.

These papers form part of a series emanating from the astronomers of the Pulkowa Observatory, and having for their object the advancement of sidereal astronomy; first, by a new and more accurate determination of the elements which affect the apparent places of all the stars, such as precession, nutation, and aberration, and, secondly, by an examination of the peculiarities affecting individual stars, such as annual parallax and proper motion, by which alone we can gain a knowledge of the scale on which the visible universe is constructed, and of the arrangement in space and of the relative motions of the bodies of which it is composed.

These important objects have been steadily pursued at the Pulkowa Observatory, under the guiding mind of its illustrious director, with an energy and success which have placed that establishment in a position with respect to sidereal astronomy, similar to that which our own observatory of Greenwich occupies with respect to the observation of the moon.

The order of date, as well as the nature of the subjects treated of, leads me first to speak of M. Peters' paper on the constant of nutation. But before proceeding to give an account of the paper itself, it may not be out of place to advert rapidly to former researches respecting nutation.

When Newton traced the precession of the equinoxes to its cause in the attraction of the sun and moon on the protuberant equatoreal zone of the terrestrial spheroid, he perceived that the sun's action would likewise cause a nutation of the earth's axis, the period of which is half a year. He contents himself with remarking that this nutation can be scarcely sensible.

In the same way, of course, the moon's action produces a small nutation of which the period is half a month. Abstracting these nutations, the tendency of the sun's action is to make the pole of the equator move in a circular arc about the pole of the ecliptic;

and in a similar manner the moon's action tends to make the pole of the equator describe a circular arc about the pole of the moon's orbit for the time being. Now, as this latter pole moves in a circle about the pole of the ecliptic in a period of about nineteen years, it is easy to see that this will give rise to an inequality in the rate of precession, and to a change of the obliquity of the ecliptic, having the same period.

It is curious, however, that Newton does not allude at all to this, which constitutes by far the most important part of nutation; and this is the more remarkable, since the principles which he lays down in treating of precession are quite sufficient to obtain, by means of very simple geometrical reasoning, not only the law, but, very approximately, the coefficients of the inequalities in the precession and obliquity due to this cause.

The state of practical astronomy, however, in Newton's time, was not sufficiently advanced to induce him to enter more fully into this subject; and it was, consequently, reserved for the immortal discoverer of aberration to detect these motions of the earth's axis by means of his observations, and then to trace them to their true cause. While discussing the observations which led him to the discovery of aberration, Bradley noticed that the annual changes of declination of the stars did not exactly correspond with those which would be occasioned by precession, and he made allowance for this by employing in the reduction of his observations the changes deduced from the observations themselves.

No sooner, therefore, had Bradley determined the law and the cause of aberration, than a new subject of investigation presented itself, requiring a much longer course of observations for its complete examination. Comparing his observations of different stars, he found that their changes of declination were such as might be attributed to a real motion of the earth's axis, and he was not slow in perceiving that the varying action of the moon upon the equatoreal parts of the earth, according to the different positions of the nodes of the lunar orbit, was the probable cause of this motion. During the course of the observations, Bradley communicated what he had observed to Machin, who was then "employed in considering the theory of gravity and its consequences with regard to the celestial motions," mentioning at the same time what he suspected to be the cause of these phenomena.

Machin confirmed this supposition, and showed that the observed motions might be very nearly accounted for, by supposing that the pole of the equator described a small circle about its mean position as centre, during a period of the moon's nodes.

Bradley remarked that his observations would be more completely represented by supposing the true pole to move about the mean pole in an ellipse instead of in a circle, the major axis being in the solstitial colure; and this conclusion is perfectly true, the minor axis being, however, a little smaller than he made it.

Bradley continued the observations during an entire revolution of the moon's nodes, and then published an account of his discovery

in the *Philosophical Transactions for* 1748, in a paper which is a perfect model of lucid statement and strict inductive reasoning.

In the following year, D'Alembert succeeded in determining the true motion of the earth's axis by means of analysis, in his "Recherches sur la Précession des Equinoxes et sur la Nutation de l'Axe de la Terre," and since that time the subject has been repeatedly treated of by physical astronomers. The most complete and elegant theoretical investigation, however, of the motion of the earth about its centre of gravity is that given by Poisson in the seventh volume of the *Mémoires de l'Institut.* The theoretical investigations with respect to nutation leave nothing to be determined by observation, except the value of one constant. This is generally chosen to be the coefficient of the principal inequality in the obliquity of the ecliptic. The accurate determination of this constant is important, not only from its being required for the reduction of star observations, but also from its affording one of the best means we have of determining the mass of the moon.

In precession we see the effect of the joint action of the sun and moon, but by means of the observed quantity of nutation, we can ascertain what part of this is due to the moon's action, and having thus obtained the ratio between the actions of the sun and moon, the moon's mass easily follows.

The most trustworthy determinations of the constant of nutation, previous to this of M. Peters, are those of MM. Von Lindenau, Brinkley, Robinson, and Busch; and M. Peters begins his memoir with a critical examination of their labours.

The results of the three latter astronomers present an admirable agreement, while that of Von Lindenau differs from them by about a quarter of a second. Von Lindenau employed about 800 observations of right ascension of *Polaris*, made at different observatories, and therefore his result is liable to be vitiated by the different personal equations of the several observers. We shall find in the sequel that this remark is important.

Brinkley deduced his value of the constant from 1618 observations of ten stars made about the times of two opposite maxima of nutation in declination with the Dublin meridian circle, the proper motions of the stars being determined by the comparison of his own declinations with those in the *Fundamenta.* As these observations embrace only half a period of the moon's nodes, the result is liable to be affected by errors in the supposed proper motions.

Dr. Robinson's investigation is contained in the eleventh volume of the *Memoirs* of the Royal Astronomical Society. He employs the declinations of the polar star, and of fourteen others observed at Greenwich between the years 1812 and 1835 with Troughton's mural circle. There can be no doubt of the high value of this investigation, but M. Peters thinks that, in consequence of the way in which the error of collimation is determined, errors of observation may exist with a yearly period, and that these may slightly affect the resulting value of nutation. Baily's coefficient of aberration is.

employed, the annual parallaxes of the stars are neglected, and the equations of condition are not treated by the method of least squares.

M. Busch has deduced the constant of nutation from Bradley's observations at Kew and Wansted. The reductions are made in the most strict manner, except that the annual parallaxes are neglected, and M. Peters regards the result as worthy of the highest confidence.

M. Peters then enters upon his own investigations, which are based on 603 right ascensions of *Polaris*, observed at Dorpat between 1822 and 1838, with Reichenbach and Ertel's meridian circle. Of these observations, the first 249 were made by M. Struve, and the remaining 354 by M. Preuss. These are compared with the right ascensions deduced from the *Tabulæ Regiomontanæ*, and the equations of condition thence arising are treated by the method of least squares, taking as the unknown quantities the correction of the constant of nutation, the correction of the constant of aberration, the annual parallax, the corrections for the position of the axis of the transit-circle (illuminated pivot east or west), the correction of the star's right ascension, and the personal equation of the two observers.

The equations are first solved, giving equal weight to all the observations. The observations are then divided into two groups (one for each observer), and the equations of each group are solved separately. There is a surprising agreement between the results found from the four years' observations of M. Struve, and the twelve years' observations of M. Preuss, the coefficients of nutation deduced differing by less than three-hundredths of a second. This investigation supplies a measure of the precision of the separate observations, and it is found that M. Struve's observations are entitled to greater weight than those of M. Preuss.

The whole of the observations are then combined, giving the proper relative weights just obtained, and the equations are re-solved. The values found for the unknown quantities differ extremely little from the results given by the supposition of equal weights.

One of the most striking results is the constant difference between the right ascension given by the two observers, or the personal equation, which amounts, for *Polaris*, to more than 0·8 of a second of time. The magnitude of this shows that the personal equation changes with the declination of the stars. Hence, also, we may easily understand that M. Lindenau's results may be vitiated by the omission of the consideration of personal equation, especially as the observations which he employed were made with different instruments, as well as by different observers.

While M. Peters was employed in these investigations, M. Lundahl was likewise engaged in discussing the observations of declination of the same star, made also at Dorpat within the same space of time. The value of the constant of nutation which he deduces agrees admirably with those found by MM. Peters and Busch.

Finally, M. Peters takes the mean of the three results, giving

the proper relative weights to the several determinations, and he finds the most probable value of the constant to be 9″·2231 with the probable error 0″·0154. This value differs very little from Brinkley's, which has generally been employed by English astronomers, but M. Peters' determination undoubtedly possesses much greater weight.

M. Peters next enters upon a theoretical investigation of nutation, far more complete than any that had before appeared. Starting from the equations of Poisson's theory, he developes them, taking into account the ellipticities of the orbits of the earth and moon, and also the principal lunar inequalities. He thus obtains a great number of small terms which had previously been neglected. Most of these may be safely omitted; but there are two terms which should be taken into account in delicate investigations, as they have an annual period, and are therefore mixed up with the effect of aberration and parallax. M. Peters takes care to apply the requisite corrections to the coefficients of aberration, and to the parallax of *Polaris* given by his investigations. Although most of the new terms found by M. Peters are very small, yet these researches are not the less valuable, since it is always satisfactory to know what we really neglect.

M. Peters takes into account the effect of a possible difference between the ellipticities of the two hemispheres, which he determines by means of the pendulum experiments collected by Mr. Baily in his "Report on the experiments made by Foster," in the seventh volume of the *Memoirs* of the Royal Astronomical Society. It fortunately happens that this effect is insensible, as this difference of the two hemispheres is extremely doubtful.

The last part of M. Peters' paper contains researches on the obliquity of the ecliptic and the precession of the equinoxes, so that he treats of all the elements which relate to the apparent changes in the places of the stars, due to the motion of the pole of the earth. He deduces the secular diminution of the obliquity of the ecliptic by comparing the obliquity for 1757, given by Bradley's observations, with that for 1825 given by the observations of Dorpat, both being reduced to the mean by the new value of nutation. The rate of the diminution so found agrees very well with that found by M. Le Verrier from theory, the difference not amounting to one second in a century. The true value of the obliquity of the ecliptic at a given epoch cannot, however, be considered as definitively settled, in consequence of the puzzling constant differences between the declinations determined at different observatories. For instance, the obliquity given by the mean of several years' observations at Greenwich exceeds by rather more than one second the obliquity for the same epoch given by M. Peters' investigations.

M. Peters' researches respecting precession are based on the results of M. Otto Struve's paper, which obtained our medal on a former occasion, combined with M. Le Verrier's determination of the secular change in the position of the ecliptic.

M. Otto Struve determines, independently, by observation, the

values of two constants on which the precessions in right ascension and declination depend. Now, theory establishes a relation between these constants, and M. Peters is thereby enabled to find the most probable values which result from the combination of the observed values, and thence to derive complete formulæ for precession applicable to any given epoch.

I have no hesitation in regarding M. Peters' results, with respect both to precession and nutation, as definitive for the present state of astronomy.

I now come to M. Peters' second paper, which relates to the delicate subject of the parallax of the fixed stars.

The first part of this important paper contains an historical and critical review of the researches of astronomers respecting parallax from the time of Tycho to the year 1842. The second treats of the parallaxes of several stars as determined by M. Peters' own observations, made at Pulkowa by means of the great vertical circle of Ertel. In the third part, the results of the two former are applied to determine the mean parallax of stars of the second magnitude.

The historical part is drawn up with great care, and contains many curious and interesting discussions on particular points. For instance, M. Peters shows that the coefficient of aberration may be obtained with great accuracy from Flamsteed's observations of the zenith distance of the pole-star. The probable error of a single observation is found to be only 6″, which gives a far higher idea of the accuracy of Flamsteed's observations than has been generally entertained. Bradley himself remarked, that Flamsteed's observations of the pole-star agreed with his theory of aberration.

The celebrated controversy between Brinkley and Pond is discussed at considerable length, and the labours of the latter astronomer are criticised with great severity. M. Peters considers that Brinkley was far superior to his opponent in his knowledge of the theory of his instruments and in the use of precautions to avoid error, though it is certain that Pond was the more correct in his conclusions respecting parallax.

The parallaxes determined by M. Struve at Dorpat, from 1818 to 1821, by means of observed differences of right ascension of circumpolar stars having nearly opposite right ascension, deservedly occupy a good deal of attention. The parallaxes thus found, though small, were almost all positive, and M. Peters confirms their reality by the following ingenious consideration. He shows that any diurnal variation of the instrument due to temperature will affect the coefficients of aberration and parallax in the same direction, and the former probably more than the latter. Now, the coefficient of aberration found from these observations is about 0″·08 less than the definitive value given by the Pulkowa observations, and it is therefore probable that M. Struve's parallaxes should be increased by a few hundredths of a second.

It is unnecessary for me to follow M. Peters in his account of Struve's micrometrical measurements of the parallax of α Lyræ, of *Bessel's well-known* observations of 61 *Cygni* with the heliometer,

and of the parallaxes of *α Centauri* and *Sirius*, as determined by MM. Henderson and Maclear at the Cape, as these have been fully discussed by Mr. Main in an able paper in the twelfth volume of our *Memoirs*. The Council is also indebted to Mr. Main for a careful report on M. Peters' paper, from which I have derived considerable assistance in drawing up my account of it.

The second, and most important, part of M. Peters' paper consists of an investigation of the parallaxes of eight stars, by means of observations of zenith distance made by M. Peters at Pulkowa, in 1842 and 1843, with Ertel's great vertical circle. The stars selected are *Polaris*, *Capella*, *ι Ursæ Majoris*, *Groombridge* 1830, *Arcturus*, *α Lyræ*, *α Cygni*, and 61 *Cygni*.

The utmost care is taken in the instrumental adjustments, in the equalisation of the interior and exterior temperatures, and in eliminating every imaginable source of error.

It would be impossible for me to convey an adequate idea to any one unacquainted with M. Peters' paper, of the numerous precautions used by him for this purpose. For instance, the observations are made by placing the wire very near the star and then waiting for the time when the star is exactly bisected by it. The large motions of the instrument are always made without touching either the telescope, or the divided circle, or the pieces carrying the microscopes. In making the double observation (face East and face West) the micrometer-screw is always turned finally in the same direction, the reading of the levels is always commenced at the same end of the scale (though they are protected from heat by glasses). The effect of flexure of the telescope-tube is eliminated by an important arrangement, by which the eye-piece and object-glass are capable of being fixed at pleasure at either end of the tube. This transposition was made after every eight complete observations of the sun.

At every observation the readings of the microscopes are taken for coincidence with both the preceding and succeeding divisions on the limb, and the utmost pains are employed to correct for any inequality in the micrometer-screw and for errors of division.

Again, in the reduction of the observations and the elimination of the unknown quantities, the same attention to minute accuracy is observable. Thus, small terms are introduced into the expressions for aberration and nutation which had hitherto been neglected, and an elaborate investigation is entered into respecting the proper motions of the stars observed. The unknown quantities to be determined are the correction to the assumed latitude, the flexure of the telescope tube, the correction of the thermometrical coefficient of refraction, the correction of the assumed mean declination, the annual parallax, and the correction of the coefficient of aberration. Of these, the first three are found by means of the observations of the pole-star. All the equations are solved by the method of least squares, and the greatest care is used in estimating the probable errors of all the results, whether arising from probable errors of observation or uncertainty in the elements employed in the calculation.

There are also discussions on some curious points, such as the effect of clouds on refraction, the possible variability of latitude, &c. The resulting values for parallax are all positive, with the exception of that of *a Cygni*, which comes out a minute negative quantity; this, of course, only indicates that the real parallax of that star is probably extremely small.

The constant of aberration obtained by taking the mean of the several results for the different stars is 20″·481, which differs only 0″·036 from the definitive value found by M. Struve. The smallness of this difference gives great confidence as to the accuracy of the results for parallax, as there is no reason why the aberration should be found more accurately than the parallax.

Another strong confirmation is afforded by the fact, that the parallax of 61 *Cygni* determined by M. Peters is absolutely identical with that found by Bessel by means of the heliometer.

The last part of M. Peters' paper treats of the mean value of the parallax of stars of the second magnitude. M. Peters finds that there are thirty-five stars whose parallaxes are determined with sufficient accuracy to serve as a basis in this research. Of these, however, he excludes two stars which have very large proper motions, 61 *Cygni* and 1830 *Groombridge*, as exceptional, and therefore not properly to be included when an average is the quantity sought. Struve's scale of relative distances of stars of different magnitudes is employed in combining the observed parallaxes for different stars, although the final result is nearly independent of the assumed scale, inasmuch as the second magnitude is nearly the mean of all the magnitudes of the stars employed.

M. Peters shows his usual skill in estimating the probable errors which may arise from the defects of the hypotheses employed, such as that of the same absolute brightness of the stars, as well as from the errors of the observed parallaxes; and he finally arrives at the result, that the most probable value of the mean parallax of stars of the second magnitude is 0″·116, and that the probable error of this determination is only 0″·014.

M. Peters closes his paper with a most interesting result deduced by combining his own researches with those of M. Otto Struve respecting the solar motion. M. Otto Struve finds that the annual apparent motion of the sun, as seen at right angles from a point at the mean distance of stars of the first magnitude, is 0″·339. Now, according to M. Peters, the mean parallax of a star of the first magnitude is 0″·209; so that we are able to turn the former result into absolute measure. Thus the annual motion of the sun with respect to the great body of the surrounding stars is equal to 1·623 times the radius of the earth's orbit.

I cannot but regard this work of M. Peters as a perfect model of excellence, evincing consummate skill in the observer, as well as admirable power of turning the observations to the best account. It shows that it is possible by meridional observations to obtain absolute parallaxes almost as small as the relative parallaxes that can be measured by the heliometer or by similar means; though to do

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so requires a most rare union of instrumental advantages, care and judgment in the observer, and analytical skill in combining in the best manner the results of observation.

No one can read the papers of M. Peters, or those of the Russian and German astronomers generally, without being struck with the constant employment of the method of least squares. It is to be wished that this method were more in use among English astronomers, as I believe not a little of the precision of modern determinations is due to it. We seem to entertain a distrust respecting the results of the calculus of probabilities, more particularly with regard to the estimation which it affords of the probable amount of error in any determination.

It should be borne in mind, that when we speak of the probable error being of a certain amount, it is not meant that it is improbable that the error should exceed that amount, but only that it is as probable *à priori* that the error falls short of, as that it exceeds it. If we know by independent means that the error of any determination is much greater than the probable error given by the observations, we may infer, with great probability, that some constant cause of error has occurred in the observations employed. In the estimation of probable error, only fortuitous causes of error are taken into account. The employment of the method of least squares does not render it less necessary to avoid all sources of constant error: it is not a substitute for, but an auxiliary to good observations, and enables us to obtain from them all that they are capable of yielding.

I cannot conclude without congratulating the Society on the improved prospects of that very delicate branch of astronomy which relates to the research of stellar parallax, especially as there is every reason to believe that this country will contribute its full share to the advancement of it. We may hope that the beautiful reflex zenith telescope of the Astronomer Royal, the magnificent heliometer which is in the able hands of Mr. Johnson, and the improved method of recording star transits by means of galvanism, will enable us ere long to take many firm, though long-reaching, steps into regions of space hitherto untrodden.

(*The President then, delivering the Medal to Mr. Hind, Foreign Secretary, addressed him in the following terms*) :—

In transmitting this medal to M. Peters, you will assure him of our high appreciation of the importance of the results at which he has arrived, and of the admirable science and skill which he has shown in obtaining them; and you will express our confident hope that in his new sphere at Konigsberg, he will confirm and add to the reputation which he has so deservedly acquired at the observatory of Pulkowa.

The Meeting then proceeded to the election of the Officers and Council for the ensuing year, when the following Fellows were elected :—

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ROYAL ASTRONOMICAL SOCIETY.

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Capt. W. H. SMYTH, R.N., Vice-President, in the Chair.

Isambard Kingdom Brunel, Esq., Duke Street, Westminster,
Edward Vogel, Esq., Assistant at Mr. Bishop's Observatory, South Villa, Regent's Park,

were balloted for and duly elected Fellows of the Society.

Discovery of a new Planet by Dr. A. de Gasparis.

"I have the honour to inform you that on the evening of March 17 I discovered a new planet. It resembles a star of 10.11 magnitude, and is at present near *Regulus*, with which I have compared it."

Apparent Positions.

1852.	Naples M.T. h m s	R.A. h m s	Decl. ° ′ ″	No. of Obs.
Mar. 17	9 52 32·5	9 57 56·7	+12 51 20	2
19	8 20 18·6	9 56 54·2	+12 58 19	7
20	9 25 27·1	9 56 21·2	+13 1 41	2

Note on the Discovery of the New Planet of De Gasparis. By Mr. J. R. Hind, For. Sec. R. Ast. Soc.

On the 3d of April, letters arrived in this country from Professor De Gasparis, of Naples, announcing his discovery of a new planet on the evening of the 17th of March. It is described as resembling a star of the 10.11th magnitude.

The object of the present remarks is to show that the existence of this planet had been detected at Mr. Bishop's Observatory on the 18th of March, the night after the actual discovery at Naples.

On the 29th of January, during a final revision of the ecliptical chart for Hour x, prior to placing it in the engraver's hands, I entered an object shining as a star of the eleventh magnitude in R.A. $10^h\ 32^m\ 40^s$, Decl. $+8°\ 59'$ (as nearly as the map will give it): some other small stars were entered the same evening, and the

chart was believed to be complete. Every night for the week following proved cloudy, and in order to cause as little delay as possible in the publication of the map, the working copy was taken to the engraver, and the re-examination of the few stars marked upon it towards the end of January was deferred until a proof arrived. Considerable delay occurred, and we did not receive a perfect copy before the 18th of March. The evening being very fine, I compared the whole chart with the heavens, and immediately missed the star of the eleventh magnitude observed on January 29. I was certain of its planetary character and commenced a search for it at once. Supposing it to have been a distant planet (which, from its proximity to the ecliptic and faintness, was by no means improbable), it could not have retrograded more than three or four minutes in right ascension; but, on carefully looking over the neighbourhood, there appeared to be no star of the eleventh magnitude unmarked in its proper place upon the chart. The search was, therefore, conducted on the supposition that the missing star belonged to the group of minor planets: in this case it had probably retrograded into the chart for 9^h R.A. at present in an unfinished state, and I forthwith commenced mapping in every star to the eleventh magnitude inclusive, confining my attention on the 18th chiefly to the small stars lying more than $1^\circ\frac{1}{2}$ from the ecliptic north and south. This appeared desirable, because a planet with an inclination of 8° or 10° might have passed over several degrees of latitude since the 29th of January. On March 20th I renewed the search, but found all the stars of March 18 in their places; I, therefore, inserted those situated nearer to the ecliptic, and amongst them, one placed on the map in R.A. $9^h\ 56^m\ 30^s$, Decl. $+ 13^\circ\ 4'$, and noted as of the eleventh magnitude. During the ensuing fortnight the thick weather and moonlight effectually prevented us from carrying on the search, and at the time the announcement from Naples reached us we were merely waiting for a clear dark night to continue it. The observation by Professor de Gasparis on March 20 gives for the position of the planet a place agreeing so nearly with that of the star of eleventh magnitude inserted on our chart on the same night, that there can remain little doubt of my having again seen the planet, particularly as this star also is now missing.

In offering these remarks, I must disclaim on the part of Mr. Bishop and myself the most remote intention to interfere with the just claim of Professor de Gasparis to the merit of this discovery. A comparison of dates will prevent misapprehension on this point. The planet was actually detected as such at Naples on the 17th of March, while I was not aware of its existence until the following night. A week or two longer would no doubt have led to our recognising the planet again, had it escaped the admirable plan of examination of the heavens at present pursued by Professor de Gasparis.

Until the orbit of the new planet is calculated, we cannot, of *course, decide* whether it really occupied the position of the missing

star of January 29th; I am satisfied the object seen that night was a small planet, and the fact of my having actually mapped in the new one as a star of eleventh magnitude, on March 20, was entirely owing to this conviction.

The copy of the ecliptical chart for 10^h, in the possession of the Society, contains the star of the eleventh magnitude inserted on January 29, which there is reason to suppose to have been the new planet.

The following positions have been obtained with Mr. Bishop's equatoreal:—

1852.	Greenwich M.T. h m s	R.A. h m s	Decl. ° ′ ″
April 3	11 43 58	9 51 14·03	76 22 30·5
	12 4 25	14·00	33·7
4	8 38 18	9 51 3·94	76 21 20·6

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1852.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$.	N.P.D. ° ′ ″	Log $\frac{q}{P}$.	Star of Comp.
April 7	8 35 26·1	9 50 33·75	−7·594	76 17 17·4	−9·8032	α Leonis
	8 52 23·2	33·52	−6·855	17·8	9·8027	—
	9 12 20·2	33·18	+7·428	15·6	9·8028	—
8	8 59 18·2	9 50 26·15	+7·031	76 16 10·9	9·8025	—
	9 17 15·6	25·93	7·632	9·3	9·8031	—
9	10 17 5·8	9 50 20·45	+8·186	76 15 5·7	9·8095	—
	10 47 1·0	19·80	8·305	4·4	9·8147	—
10	8 42 16·8	9 50 15·20	−6·730	76 14 14·8	9·8023	—
	9 0 14·0	14·85	+7·428	11·9	9·8024	—
11	8 17 21·6	9 50 11·57	−7·632	76 13 26·1	9·8023	—
	8 39 18·4	11·50	6·554	21·6	9·8022	—
12	8 33 19·1	9 50 8·79	−6·854	76 12 42·5	9·8021	—
	8 53 16·0	8·89	+7·456	40·2	9·8024	—
13	10 51 3·6	9 50 7·95	+8·369	76 12 3·1	9·8190	—
	11 11 0·8	7·80	8·416	0·1	9·8236	—
14	10 39 8·5	9 50 7·79	+8·343	76 11 35·4	9·8168	—
	10 59 5·2	7·69	8·397	35·3	9·8215	—
15	10 57 10·4	9 50 9·48	8·402	76 11 18·3	9·8220	—
	11 17 7·5	9·21	+8·447	17·8	−9·8272	—

The observations are corrected for refraction. The corrections to be applied for parallax in seconds of time and arc are represented by p and q. P is the equatoreal horizontal parallax.

The following is the assumed *mean* place of the Star of Comparison for 1852·0, derived from the Greenwich Observations for 1850.

	R.A.	N.P.D.
	h m s	° ′ ″
α Leonis	10 0 29·14	77 18 40·40

The sky on the 9th was very hazy, and the observations of the planet were marked "exceedingly faint and not good."

HAMBURG. (M. C. Rümker.)

1852.	Hamburg M.T.	App. R.A.	Decl.	No. Obs.
	h m s	h m s	° ′ ″	
April 11	8 58 14·6	9 50 11·84	+13 46 47·6	6
14	9 2	50 8·35	48 19·6	2
15	8 47	50 9·77	48 37·5	1
16	8 46 31·2	9 50 11·51	+13 49 1·2	6

Apparent Places of the compared Stars according to the Hamburg observations with the Meridian Circle.

	R.A.	Decl.
	h m s	° ′ ″
April 4	9 49 11·35	+13 51 30·0
16	9 49 11·34	+13 51 29·8

Elements.

Computed from the Naples Observation of March 19 and the South Villa Observations of April 3 and 12, by M. Edward Vogel, F.R.A.S., of the South Villa Observatory.

	° ′ ″	
M	77 38 43·33	April 0·1852, 0h Berlin M.T.
π	33 36 43·23	M. Eq. 1852, Jan. 1.
☊	151 11 36·52	M. Eq. 1852, Jan. 1.
i	3 30 14·67	
φ	24 39 56·22	
Log *a*	0·4865700	
μ	660″·9250	
dl	= −0″·10	Computed − Observed.
db	= 0″·00	Computed − Observed.

By M. George Rümker.

From the *Naples* observations of March 19 and 29, and the *South Villa* observations of April 4.

	° ′ ″	
M....................	= 280 25 21·5	1852, April 1·0, Berlin T.
π....................	253 56 20·8	Mean Eqx, 1852, Jan. 0·0.
☊	150 14 11·7	Mean Eqx, 1852, Jan. 0·0.
i	2 43 8·1	
φ	7 42 56·3	
Log *a*	0·4965374	
Log μ	2·8052005	

These elements represent the middle observation exactly, but they must be considered merely as approximate.

Ephemeris. By M. E. Vogel.

For Berlin Mean Noon.

1852.	R.A. h m s	Decl. ° ′	Log Δ.
April 20	9 50 28	+13 49·3	0·45354
21	50 35	49·0	
22	50 43	48·6	
23	50 54	48·1	
24	51 5	47·6	·46376
25	51 17	46·9	
26	51 30	46·1	
27	51 44	45·2	
28	52 0	44·3	·47393
29	52 16	43·3	
30	52 33	42·2	
May 1	52 51	41·0	
2	53 10	39·7	·48402
3	53 30	38·3	
4	53 51	36·8	
5	54 13	35·2	
6	54 36	33·5	·49399
7	55 0	31·7	
8	55 25	29·9	
9	55 50	27·9	
10	56 16	25·9	·50381
11	56 43	23·8	
12	57 12	21·6	
13	57 41	19·3	
14	58 11	16·9	·51346
15	58 42	14·5	
16	59 13	12·0	
17	9 59 46	9·4	
18	10 0 19	6·7	·52294
19	0 53	4·0	
20	10 1 28	+13 1·2	0·52761

M. George Rümker has also been kind enough to forward an ephemeris calculated upon his elements, which, however, arrived after M. Vogel's elements were in type. The following quantities must be applied to M. Vogel's ephemeris to produce M. Rümker's.

	R.A. m s	Decl. ′
April 20	+0 16	−1·1
30	+0 47	−3·4
May 10	+1 32	−7·3

FLORA.

Durham. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1852.	Green. M.T. h m s	R.A. h m s	Exc. of Ephem. s	N.P.D. ° ′ ″	Exc. of Ephem. s	No. of Comps. in R.A.	N.P.D.	Set.
Mar. 2	12 50 19·9	12 49 50·72		85 50 17·2		24	8	1
3	12 6 35·7	49 11·21		85 43 7·2		18	6	2
9	12 28 14·6	44 37·28	− 9·77	84 57 23·5	−57·4	18	6	3
24	14 38 24·7	12 30 38·68	−10·06	83 3 3·9	−53·8	18	6	4

Corrected for refraction and parallax, and compared with the ephemeris circulated by the superintendent of the *Nautical Almanac.*

Assumed *Mean* Places of Stars of Comparison, 1852·0.

Name.	R.A. h m s	N.P.D. ° ′ ″	Set.
B.A.C. 4340	12 48 9·16	85 47 50·2	1, 2
Weisse, xii[h], 787	46 8·98	84 57 19·8	3
— — 536	12 32 12·23	83 4 8·5	4

Set 1. Good observation. *Flora* about 9½ magnitude.
— 4. Sky very changeable. Measures obtained with difficulty.

Liverpool. Equatoreal. (Mr. Hartnup.)

1852.	Green. M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	Compᵈ—Obsᵈ s	″	Stars of Comp.
April 8	11 13 54·5	12 16 24·25	81 34 27·5	−9·80	−51·4	B.A.C. 4072
	11 39 49·5	23·03	23·3	9·54	52·3	— —
10	10 15 27·2	12 14 41·99	81 25 49·8	−9·23	−52·1	— —
	10 45 21·0	40·94	46·4	9·24	54·0	— —
11	10 4 43·0	12 13 50·94	81 21 41·5	−8·72	−50·5	— —
	10 29 38·6	50·25	35·2	8·91	48·5	— —

The observations are corrected for refraction and parallax. The computed places are interpolated from the ephemeris circulated by the Superintendent of the *Nautical Almanac.*

The assumed *mean* place of the Star of Comparison for 1852·0, derived from the Greenwich Observations, is as follows:—

	R.A. h m s	N.P.D. ° ′ ″
B.A.C. 4072	11 57 40·23	80 26 41·55

EUNOMIA.

Hamburg. (M. Rümker.)

1851.	Hamburg M.T. h m s	App. R.A. h m s	App. Decl. ° ′ ″
Oct. 18	6 58 4·2	282 10 41·7	−20 52 24·7
25	6 46 19·8	284 29 49·3	−20 24 45·7

Not corrected for parallax.

PARTHENOPE.

Hamburg. (M. Rümker.)

1851.	Hamburg M.T. h m s	App. R.A. ° ′ ″	App. Decl. ° ′ ″
Oct. 17	9 44 35·7	29 51 42·1	+3 45 56·6
18	11 4 14·6	29 37 4·3	3 40 0·1
Nov. 2	8 3 22·7	26 14 45·8	2 29 44·4
Dec. 19	10 57 35·9	22 49 0·0	3 5 13·8
25	6 57 3·3	23 24 34·3	+3 35 40·6

VICTORIA.

Durham. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1852.	Green. M.T. h m s	R.A. h m s	Exc. of Ephem. s	N.P.D. ° ′ ″	Exc. of Ephem. ″	No. of Comps. in R.A.	No. of Comps. in N.P.D.	Set.
Jan. 12	11 46 5·1	7 46 40·04	−4·53	80 1 41·2	−10·8	21	7	10
17	9 49 8·8	41 28·83	4·13	79 54 37·3	14·0	21	7	11
	13 19 27·5	20·13	4·64	23·0	14·4	22	8	12
18	12 53 28·6	40 17·96	4·30	52 42·6	15·9	15	5	13
19	9 9 50·6	39 24·72	4·08	51 16·3	(20·9)	3	1	14
23	10 19 10·8	35 14·41	4·24	42 63·3	12·7	24	8	15
	12 30 56·7	8·52	3·93	51·7	13·0	12	4	16
24	11 41 25·9	34 10·02	3·92	40 43·0	11·1	15	5	17
	12 28 59·6	8·63	4·52	40·2	12·7	15	6	18
25	9 44 51·6	33 15·20	4·23	38 39·4	11·5	10	5	19
	12 12 32·5	9·24	4·40	26·5	12·6	24	8	20
26	10 15 30·6	32 14·59	4·21	36 16·2	9·9	12	6	21
28	8 51 27·6	30 21·68	4·26	31 39·5	13·0	20	7	22
30	8 54 46·2	28 28·13	3·80	26 38·2	13·3	16	8	23
31	9 46 21·7	27 31·26	−3·92	23 56·5	−12·3	23	8	24
Feb. 5	10 7 5·2	23 11·73	...	10 20·8	...	16	8	25
6	9 0 6·8	22 25·62	...	79 7 38·0	...	24	8	26
9	10 44 43·3	20 5·36	...	78 58 51·6	...	9	3	27
10	8 58 1·9	19 25·87	...	56 7·6	...	12	4	28
13	12 42 12·4	17 19·56	...	46 49·4	...	24	8	29
15	8 57 13·1	16 12·48	...	41 21·7	...	10	5	30
21	9 58 8·2	13 10·27	...	23 15·4	...	24	8	31
22	9 51 12·7	7 12 45·82	...	78 20 18·6	...	18	6	32

The parallaxes and computed places for January were taken from the ephemeris for the opposition circulated by the Superintendent of the *Nautical Almanac*, based on the elements of M. Villarceau; the parallaxes for February were deduced from the values of log Δ, given in the *Berliner Astron. Jahrbuch for* 1854.

Victoria was on all occasions this year below the 10th magnitude, estimated according to Bessel's scale.

Assumed *Mean* Places of Stars of Comparison, 1852·0.

Name.	R.A. h m s	N.P.D. ° ′ ″	Set.
Weisse, vii^h, 1469	7 49 22·25	80 7 21·1	10
— — 1219	40 5·82	79 55 12·4	11
— — 1195	39 27·61	80 0 49·1	12
— — 1135	37 32·35	79 47 10·2	13, 14, 15
— — 821	26 51·07	42 39·7	16, 17
— — 906	29 27·12	38 8·8	18, 19, 21
— — 826	27 4·32	33 42·4	20, 22
— — 898	29 10·68	22 13·3	23, 24
— — 799	25 56·02	79 6 56·2	25, 26
— — 720	23 30·85	78 57 46·0	27, 28
— — 473	15 49·29	48 41·4	29
— — 555	18 30·21	42 0·0	30
— — 302	7 10 2·90	78 18 47·2	31, 32

Sets 19, 21, 23, 25, and 30, were taken by the hearing-tube, in consequence of high winds.

— 12. The N.P.D. of Weisse, vii^h, 1195, here depends on 1174 and 1219.

— 14. The N.P.D. is worthless: it is the result of a single bisection under very unfavourable circumstances.

— 27, 28. Interrupted by haze.

— 29. Sky foggy, and full of snow. Planet badly seen.

— 31. Many small stars in the field, one following in 5^s; but no doubt about the identity of the planet.

Some Corrections of Weisse's Catalogue.

Weisse, vii^h, 761, appears to have originated in an error of 1 revolution = 34″·1 in declination: assuming this, its declination for 1825 will be + 10^h 56^m 17^s·5, and the star becomes identical with 760. There is no such double star as these would otherwise form.

— — 986. No such star exists in the heavens, nor can I find it in Bessel's Zones.

— — 1135, is wrongly reduced in R.A. Its R.A. for 1852·0 should be 7^h 36^m 3^s·49.

— — 1174, requires 2^m to be added to its R.A.; and the precessions must be looked to accordingly.

— — 1469. The seconds of R.A. should be 53^s, not 55^s.

HAMBURG. Equatoreal. (M. C. Rümker.)

1852.	Hamburg M.T. h m s	App. R.A. ° ′ ″	App. Decl. ° ′ ″	Comp.
Jan. 21	9 52 33·3	114 20 5·6	+10 12 43·9	10
22	8 12 52·5	114 5 48·7	14 28·8	15
24	7 29 18·6	113 35 51·7	18 46·7	2
26	9 23 9·0	113 4 44·9	23 24·1	11
27	7 47 7·0	112 51 1·8	+10 25 41·2	1

Apparent Places of Stars compared with *Victoria*.

	App. R.A. h m s	App. Decl. ° ′ ″	Comp.
Jan. 21	7 37 32·859	10 12 45·3	Jan. 21 and 22
24	33 37·312	2 47·5	24 and 26
27	7 27 4·845	10 26 12·8	27

EGERIA.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1852.	Green. R.A. h m s	R.A. h m s	N.P.D. ° ′ ″	Compᵈ—Obsᵈ. R.A. s	Compᵈ—Obsᵈ. N.P.D. ′ ″	Star of Comp.
ar. 18	10 46 10·0	11 50 49·01	65 19 1·3	−49·73	−5 15·0	B.A.C. 3990
	11 6 6·1	48·18	3·2	49·81	5 16·7	— —
20	10 20 10·6	11 48 38·85	65 20 7·3	49·49	5 10·5	— 4056
	10 35 7·6	38·11	8·9	49·42	5 11·5	— —
23	9 19 19·7	11 45 27·72	65 23 59·3	48·91	5 8·2	— 3964
	10 41 15·2	26·62	60·0	−48·73	−5 7·4	— —

The observed places are corrected for refraction and parallax. The computed places were deduced from the ephemeris circulated by the Superintendent of the *Nautical Almanac*.

The following are the assumed *Mean* Places of the Stars of Comparison for 1852·0:—

	R.A. h m s	Decl. ° ′ ″	Authorities.
B.A.C. 3990	11 40 20·80	68 57 30·25	Greenwich and Edinb. Observations.
— 4056	54 9·34	67 4 50·30	Edinburgh Observations.
— 3964	11 53 5·08	67 49 29·37	— —

DURHAM. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1852.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	No. of Comps. in R.A.	No. of Comps. in N.P.D.	Set.
n. 25	13 48 46·7	12 25 42·92	−8·387	68 58 51·3	−9·7722	24	8	1
	14 22 55·4	43·42	8·284	48·2	9·7602	18	6	2
28	12 33 21·0	25 54·01	8·514	44 70·8	9·7992	14	6	3
	13 12 18·6	53·81	8·446	53·8	9·7806	18	6	4
	14 41 31·3	53·99	8·154	32·7	9·7492	15	5	5
30	12 58 28·3	25 51·53	8·460	35 4·7	9·7819	15	7	6
31	12 21 43·9	25 47·25	8·515	30 8·9	9·7973	10	5	7
eb. 3	12 15 51·1	25 22·82	8·506	14 26·9	9·7921	12	4	8
5	14 2 37·0	24 55·91	8·187	68 3 12·0	9·7432	18	6	9
6	13 39 30·4	24 40·35	8·268	67 57 46·0	9·7480	24	8	10
10	12 36 14·1	23 16·52	8·409	35 34·9	9·7621	24	8	11
	13 20 6·9	15·99	8·277	23·5	9·7445	24	8	12
13	13 21 38·5	21 51·26	8·221	67 18 24·3	9·7369	24	8	13
17	12 40 53·3	19 32·96	8·306	66 56 3·9	9·7405	23	8	14
18	12 29 31·7	18 53·54	8·330	50 43·0	9·7423	18	6	15
19	13 24 49·4	18 10·69	8·056	45 4·8	9·7222	24	8	16
25	11 36 23·8	13 31·95	8·391	14 41·7	9·7447	11	4	17
27	12 30 45·3	11 43·63	8·152	66 5 15·3	9·7183	22	7	18
ar. 2	11 55 16·2	7 56·69	8·233	65 48 53·2	9·7217	17	6	19
3	11 16 9·7	6 58·56	8·356	45 19·3	9·7333	24	8	20
9	11 17 13·8	12 0 42·36	8·249	27 58·1	9·7175	12	6	21
12	12 0 21·0	11 57 24·30	−7·867	22 31·7	9·7006	18	6	22
20	12 4 24·3	48 34·14	+6·888	20 17·5	9·6971	18	6	23
24	11 17 6·1	44 19·40	−7·625	26 6·0	9·6995	18	6	24
27	10 47 36·9	11 41 15·37	−7·898	65 33 32·6	−9·7066	9	3	25

Corrected for refraction only. The log-factors for parallax are given, as the ephemeris in the Berlin *Jahrbuch* was not quite satisfactory.

Assumed *Mean* Places of Stars of Comparison, 1852·0.

Name.	R.A. h m s	N.P.D. ° ′ ″	Set.
Bessel's Zone, 362	12 23 52·56	68 57 26·6	1
— — 362	29 24·87	56 56·6	2
Anonymous, 9th mag.	26 3·00	44 55·0	3
Bessel's Zone, 467	20 39·15	49 31·0	4
— — –	30 52·32	43 8·9	5
— — –	31 13·12	27 51·0	6, 7
— — –	24 44·42	15 43·3	8
B.A.C. 4260 (Edin. Obs.)	31 45·50	68 7 21·0	9
Lalande, 23596	29 48·00	67 59 7·0	10
Bessel's Zone, 467	27 23·99	38 1·8	11
Anonymous, 8th mag.	24 9·80	36 14·0	12
Bessel's Zone, 467	22 55·47	13 52·2	13
— — –	17 3·98	67 0 30·7	14
Anonymous, 9½ mag.	17 17·67	66 48 32·4	15
Bessel's Zone, 412	14 56·77	42 52·4	16
B.A.C. 4141	11 50·50	66 8 32·0	17, 18
Bessel's Zone, 412	4 13·84	65 51 8·1	19, 20
— — –	12 0 30·09	28 26·5	21, 22
— — 353	11 45 14·32	23 44·4	23, 24
— — –	11 32 42·72	65 34 55·6	25

Set. 1. *Egeria* fully 10th magnitude.
Sets 5, 23, 24. Sky foggy, and planet dim.
— 6, 7, 9, 14, 15, 16. Windy. Boisterous. The hearing-tube used.
— 8, 17, 25. Measures interrupted by cloud.
On other nights circumstances were favourable.

ENCKE'S COMET.

CAMBRIDGE, U.S. Great Equatoreal. (Prof. W. C. Bond.)

1852.	Camb. M.T. h m s	R.A. Comet—✱ m s	No. of Obs.	Decl. Comet—✱ ′ ″	No. of Obs.	Star of Comp.
Jan. 13	6 57 28·46	+0 8·85	17	−2 2·91	6	*a*
17	7 2 16·71	+0 15·08	16	−3 32·96	10	*b*
19	7 24 35·76	−0 21·22	9	+3 32·53	6	*c*
20	6 54 5·46	−0 6·73	10	+3 35·38	6	*d*
23	7 20 35·57	−1 5·42	8	−3 38·27	5	*e*
Feb. 2	6 58 23·46	+0 35·04	12	+3 6·80	10	*f*
14	7 35 38·39	+1 34·51	8	+2 50·93	6	*g*

Stars of Comparison referred to the Mean Equinox of Jan. 1, 1852.

Star.	R.A. h m s	Decl. ° ′ ″	Mag.	Authority.
a	23 6 29·23	+4 11 34·56	8	Weisse, xxiii, 111
b	11 18·36	36 3·28	8.9	compared with B.A.C. 8127
c	14 31·28	41 39·93	10	— — — —
d	15 34·75	4 47 57·40	...	— — — —
e	20 44·02	5 15 39·58	8	Weisse, xxiii, 413
f	34 24·43	6 25 54·91	6.7	— — 710
g	23 54 49·65	+8 7 57·25	9.10	— — 1132

Hence the following places of the comet are deduced.

1852.	Cambridge M.T. h m s	R.A. Comet. h m s	Decl. Comet. ° ′ ″
Jan. 13	6 57 28·46	23 6 38·08	+4 9 31·65
17	7 2 16·71	11 33·44	32 30·32
19	7 24 35·76	14 10·06	45 12·45
20	6 54 5·46	15 28·02	4 51 32·78
23	7 20 35·57	19 38·60	5 12 1·31
Feb. 2	6 58 23·46	34 59·47	6 29 1·71
14	7 35 38·39	23 56 24·16	+8 10 47·28

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1852.	Green. M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	Star of Comp.
Jan. 28	6 24 57·0	23 26 39·82	84 13 9·1	*a*
	6 39 56·2	40·98	9·4	–
Feb. 6	6 57 9·3	23 41 24·98	82 58 72·8	*b*
	7 25 8·8	27·73	48·6	–
10	6 54 20·8	23 48 32·09	82 24 74·9	*c*
	7 27 30·4	34·10	63·0	–
	7 42 30·2	35·30	52·4	–
19	6 58 4·1	0 5 32·77	81 12 40·3	*d*
	7 13 3·7	33·80	34·9	–
	7 28 3·9	35·02	33·5	–
	7 43 4·1	36·69	26·5	–
28	7 17 8·2	0 22 6·42	80 39 19·1	*e*
	7 39 8·7	8·18	23·7	–
Mar. 2	7 1 34·7	0 26 20·86	80 53 28·3	*f*
	7 13 34·6	21·63	31·7	–
	7 25 34·7	22·47	38·0	–
	7 37 35·1	22·71	40·4	–
7	7 3 42·6	0 29 9·44	82 21 48·0	*g*
	7 21 42·6	9·15	68·2	–
9	7 7 23·7	0 27 40·22	83 32 50·1	–
	7 27 24·5	39·24	80·0	–

The observations are corrected for refraction and parallax; the log distance for parallax was deduced from the ephemeris circulated by the Superintendent of the *Nautical Almanac.*

The following are the assumed *Mean* Places of the Stars of Comparison for 1852·0.

		R.A.	N.P.D.	Authorities.
		h m s	° ′ ″	
a	B.A.C. 8233	23 32 20·40	85 10 30·91	Greenwich Observations, 1849
b	— 8331	23 51 42·82	83 57 20·93	— — 1850
c	— 8354	23 54 56·22	82 20 12·00	Edinburgh Observations.
d	— 66	0 12 59·06	82 37 55·25	Greenwich 12-year Catalogue.
e	— 137	0 26 30·83	80 30 42·92	Edinburgh Observations.
f	— —	0 20 41·13	80 37 15·16	Santini's Catalogue of 1677 Stars.—*Mem. R.A.S.* vol. xii.
g	— 222	0 41 0·40	83 13 15·81	Greenwich Observations.

The light of the comet appeared to me much less diffused than it was in 1848–9. On favourable occasions, the appearance of the comet, with a low power, resembled that of a nebulous star, and the nucleus admitted of very accurate bisection. This was more particularly the case on and after the 19th of February.

DURHAM. Fraunhofer Equatoreal. (Mr. R. C. Carrington.)

1852.	Green. M.T.	R.A.	Exc. of Ephem.	N.P.D.	Exc. of Ephem.	No. of Comps. in R.A.	N.P.D.	Set.
	h m s	h m s	s	° ′ ″	″			
Jan. 17	6 41 16·1	23 11 14·94	+ 0·63	85 28 9·0	+ 52·3	6	6	1
	7 32 11·5	17·95	0·31	10·6	37·9	6	6	2
Feb. 8	7 5 15·8	44 56·04	0·59	82 42 1·7	4·6	9	3	3
9	6 55 19·6	23 46 42·90	0·48	82 33 32·5	+ 1·4	24	8	4
18	7 3 31·9	0 3 37·45	1·45	81 19 43·5	— 17·1	18	6	5
19	7 21 34·8	5 34·46	2·07	81 12 33·6	24·4	10	5	6
21	7 16 27·8	9 25·78	2·49	80 59 37·9	36·0	24	8	7
22	7 7 40·5	11 19 92	3·00	53 54·5	35·9	24	8	8
23	7 11 52·4	13 13·78	3·81	48 55·4	43·5	18	6	9
24	7 12 57·0	15 6·83	3·65	44 39·7	45·9	18	6	10
28	7 27 31·8	22 7·32	7·15	39 10·3	83·2	14	5	11
Mar. 2	7 46 0·5	26 23·98	10·18	80 53 42·9	140·6	12	6	12
3	7 15 5·6	0 27 27·15	+ 12·75	81 3 23·8	— 156·7	12	4	13

Corrected for refraction and parallax, and compared with the ephemeris circulated by the Superintendent of the *Nautical Almanac*.

Assumed *Mean* Places of Stars of Comparison, 1852·0.

Name.	R.A.	N.P.D.	Set.
	h m s	° ′ ″	
B.A.C. 8127 (Edin. Obs.)	23 12 48·00	85 25 29·7	1
Weisse, xxiii^{h}, 252	12 38·19	85 29 38·6	2
— — 983	23 48 3·90	82 36 2·0	3, 4
Anonymous, 9th mag.	0 1 38·20	81 12 45·0	5
Weisse, o^{h}, 126	7 48·65	81 4 16·3	6, 7
— - 219	12 51·82	80 53 6·2	8
— - 280	16 19·99	53 54·4	9
— - 317	19 15·68	40 13·1	10
— - 340	20 41·40	80 37 9·9	11
— - 436	25 49·61	81 2 48·0	12
— - 514	0 30 27·76	80 59 5·9	13

Encke's comet was first seen at Durham on January 12, and again on January 16, but high winds on both nights prevented more than a rough estimation of its position. On the 17th it was a little brighter, but still very faint, and the measures were in consequence taken with the ring-micrometer. On and after February 8 the comet was considerably brighter, and exhibited a strong condensation of central light, which admitted of accurate observation by the wire-micrometer. On the earlier evenings the coma seemed to spread slightly towards the s. f. direction, but subsequently no elliptical form was perceived. The whole extent of the coma was below two minutes of arc in all cases.

Sets 3 and 4. W. xxiii, 983, is also B.A.C. 8315, but as the B.A.C. place depends on a single observation by Flamsteed, I have preferred Bessel's. The star does not occur in any other catalogue in our collection.

Set 5. Wind troublesome. The star depends on equatorial comparisons only.

— 6. High wind, and a brilliant aurora. The hearing-tube used. The star's right ascension by catalogue has been increased 1^s, after comparison with two neighbours.

— 10. Attention distracted by the cathedral bells.

— 11. High wind and cloudy. The hearing-tube used.

— 12. Right ascension measures not good: the star was inconveniently situated.

— 13. Favourable. The comet was seen once after this, for ten minutes only, on March 9, but no observation could be procured from the want of a visible star within reach.

Haverhill. (Mr. W. W. Boreham.)

1852.	Green. M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	No. of Obs.	Star.
Feb. 10	6 44 45	23 48 30·15	82 25 10·6	4	*a*
11	6 50 14	50 21·82	16 17·9	6	*a*
12	6 54 34	52 11·08	82 7 59·4	6	*b*
13	6 43 29	23 54 2·86	81 59 50·1	5	*b*
18	7 27 38	0 3 37·55	19 27·0	3	*c*
20	7 2 55	7 28·33	81 5 46·9	3	*c*
22	6 57 43	11 19·12	80 54 0·4	6	*d*
27	6 58 6	20 27·46	38 22·4	3	*e*
28	6 38 27	22 4·66		3	*e*
	6 41 6		39 10·9	2	*e*
March 2	6 51 26	26 21·01	80 53 29·9	6	*f*
4	6 52 16	28 19·43	81 16 19·0	4	*g*
5	6 56 6	28 56·08	33 46·6	3	*g*
6	6 53 50	29 13·03	81 55 1·2	4	*g*
7	6 47 38	0 29 9·42	82 23 8·8	5	*h*

Assumed *Mean* places of Stars of Comparison, 1852·0.

Name.	R.A. h m s	N.P.D. ° ′ ″
a = B.A.C. 8315	23 48 3·82	82 35 57·1
b = — 8353	23 54 49·50	81 52 1·2
c = Weisse, 0^h, 69	0 4 12·17	81 40 57·3
d = — — 151	0 9 8·93	80 34 41·9
e = — — 340	0 20 41·37	80 37 9·7
f = B.A.C. 137	0 26 30·84	80 30 44·0
g = — 177	0 33 33·65	81 27 9·5
h = Rümker, *Ast. Nach.* No. 795	0 32 3·22	82 41 25·1

The observations are corrected for refraction, and for parallax by Lieut. Stratford's ephemeris.

The first five or six observations were all taken under unfavourable atmospheric circumstances.

March 2 was pretty good. Probable error E = R.A. ±0ˢ·034; Δ ±0″·85. The last observation is somewhat doubtful.

HAMBURG. (M. C. Rümker.)*

1858.	Hamburg M.T. h m s	App. R.A. h m s	App. Decl. ° ′ ″	Comp.
Jan. 20	6 43 6·0	348 47 4·0	+4 50 2·0	14
22	6 43 53·2	349 28 17·6	5 3 20·0	8
26	6 41 32·3	350 54 9·6	5 32 20·6	21
27	6 37 1·8	351 16 41·1	+5 39 23·4	3

Not corrected for parallax.

Mean Places of Stars for Jan. 1, 1836, in the Orbit of the Comet of Encke, extracted from the part of M. C. Rümker's Catalogue now about to be published.

Mean R.A. h m s	Prec. s	Mean Decl. ° ′ ″	Prec. ″	No. of Obs.	Mag.
23 2 53·960	+3·044	+4 6 58·38	+19·42	1	9
4 56·227	·044	50 54·90	·47	1	9
8 47·049	·044	33 0·38	·54	1	9
10 25·289	·045	33 27·20	·57	1	
11 59·445	·046	29 14·40	·61	2	b Pisc.
13 42·457	·046	4 36 24·71	·63	3	8.9
14 39·520	·042	5 39 10·20	·65	1	
15 2·400	·048	4 20 34·00	·66	2	8
16 0·774	·045	5 8 48·90	·67	1	8
16 50·402	·051	4 1 18·67	·69	1	9
19 39·006	·045	5 28 44·23	·73	4	θ Pisc.
19 55·384	·047	10 24·57	·74	2	8
21 11·457	·047	12 2·71	·76	4	9
22 1·684	·047	5 31 22·30	·77	1	9
22 33·903	·044	6 16 24·10	·78	1	9.10
23 14·449	·046	5 50 44	·79	1	
23 52·556	·045	6 10 58·31	·79	2	7.8
25 19·297	·052	4 39 20·89	·81	1	
27 54·143	·049	5 57 16·66	·85	2	8
30 48·596	·052	17 37·78	·88	2	8
32 47·965	·053	21 24·6	·90	1	9.10
32 48·966	·053	5 21 15·54	·90	1	8
23 35 34·797	+3·052	+6 20 26·51	+19·93	3	Dup.

* The MSS. of M. Rümker's contributions to this number of the *Notices* has *been unfortunately* mislaid between composition and revision.

Mean R.A.	Prec.	Mean Decl.	Prec.	No. of Obs.	Mag.
h m s	s	° ′ ″	″		
23 36 26·941	+3·053	+6 16 54·55	+19·94	5	7.8
37 53·764	·054	6 16 13·28	·95	2	9
39 49·916	·053	7 20 8·11	·96	4	7
41 17·846	·053	42 57·11	·98	2	8
42 54·733	·055	42 59·76	·99	1	
44 19·579	·056	48 29·15	+19·99	4	6
45 15·287	·057	7 35 30·70	+20·00	1	8.9
45 41·626	·056	8 18 54·43	·00	2	8.9
46 0·281	·056	8 14			9
47 14·778	·058	7 18 42·92	·01	1	7
50 21·064	·060	8 20 1·39	·02	2	9
50 25·855	·059	8 38 19·55	·02	2	8.9
54 0·134	·065	5 25 17·63	·04	1	8.9
54 0·685	·063	8 2 37·10	·04	1	6
54 1·792	·062	9 52 3·83	·04	1	9
54 5·136	·063	7 28 54·31	·04	2	8
54 6·911	·063	34 27·31	·04	3	6
54 40·180	·064	21 34·44	·04	1	8
54 40·530	·064	7 20 59·6	·04	1	
56 10·863	·066	6 21 7·0	·04	1	
23 56 55·378	+3·066	+7 52 35·52	+20·04	2	8

Mean Places for 1850 from the new Series, now in print.

Mean R.A.	Prec.	Mean Decl.	Prec.	No. of Obs.	Mag.
h m s	s	° ′ ″	″		
0 6 1·415	+3·075	+6 6 19·27	+20·05	3	9
9 26·186	·078	7 4 17·15	·04	2	9
9 51·724	·078	24 25·47	·03	1	
10 10·051	·078	1 58·11	·04	1	8
12 11·142	·080	42 0·89	·03	2	
12 52·914	·080	7 21 24·43	·02	1	
14 16·850	·080	6 10 46·68	·02	1	9
17 8·816	·083	6 58 28·88	·00	1	9
17 24·269	·083	7 2 4·98	+20·00	1	
17 35·253	·085	8 14 10·50	+19·99	1	9
17 58·129	·083	6 51 41·55	·99	1	7
18 4·389	·087	9 35 26·57	·99	1	7
18 15·555	·087	8 31 51·03	·99	1	
19 8·105	·085	8 29 14·36	·98	1	8
19 10·356	·085	7 43 56·21	·98	2	8.9
19 50·412	·083	6 24 13·11	·98	2	9
20 34·848	·090	9 22 6·76	·97	1	7
21 7·163	·087	7 33 17·31	·97	2	8
0 22 46·706	+3·092	+9 33 23·97	+19·97	1	8

Mean R.A.	Prec.	Mean Decl.	Prec.	No. of Obs.	Mag.
h m s	s	° ′ ″	″		
0 22 9·764	+3·098	+8 8 37·01	+19·96	2	
23 19·517	·090	28 37·97	·95	1	7
23 52·674	·091	8 19 58·48	·94	1	7
24 39·575	·086	6 7 34·71	·94	2	6.7
26 1·086	·089	6 51 42·77	·93	1	9
26 24·679	·096	9 28 41·72	·92	4	7
27 9·240	·097	9 28 45·51	·91	1	
27 22·702	·090	6 53 45·28	·90	1	
28 18·684	·089	19 45·80	·90	1	
31 57·036	·094	6 17 55·14	·86	1	8
33 45·261	·101	8 48 1·51	·84	1	
36 34·216	·097	6 57 2·00	·80	1	8.9
36 58·465	·096	6 47 49·11	·79	2	9
39 26·964	·100	7 19 31·94	·76	1	
40 19·592	·109	9 23 52·65	·74	2	9
40 29·444	·110	9 26 26·35	·74	2	9
40 54·261	·099	6 46 4·00	·74	2	6
42 43·090	·098	6 17 27·08	·71	7	9
42 45·141	·113	9 35 37·61	·71	1	9
44 18·391	·115	9 47 9·19	·68	1	
44 44·958	·107	7 50 56·28	·67	1	8.9
44 55·735	·102	6 53 6·92	·67	1	9
44 59·256	·112	8 59 20·80	·67	1	
45 52·336	·115	9 28 38·69	·65	1	
46 3·234	·101	6 27 37·86	·65	1	9
47 33·217	·100	6 2 19·90	·63	1	8.9
48 44·910	·113	8 24 57·59	·60	1	7.8
50 10·838	·105	6 47 56·51	·57	1	8.9
50 32·898	·102	6 1 58·18	·57	1	7.8
52 3·356	·101	5 40 22·90	·54	1	7
54 19·202	·110	7 7 47·80	·49	1	
55 9·564	·110	7 4 53·48	·48	4	5
56 0·134	·105	5 57 29·14	·46	1	8
56 48·706	·121	8 46 50·39	·45	1	8
0 58 52·917	+3·119	+8 3 45·03	+19·40	1	

SOLAR ECLIPSE *of July* 28, 1851.

Liverpool Observatory. Mr. Hartnup.

Latitude 53° 24′ 47″·7 N. Longitude 0^h 12^m 0^s·05 W.

"The observations were made with the 8½-inch equatoreally-mounted achromatic refractor. The first impressions which I saw on the sun's disc, were made simultaneously by two lunar moun-

tains at $1^h\ 57^m\ 47^s\!\cdot\!3$ Greenwich mean time. The intermediate portions of the moon's border, between these mountains, did not come in contact with the sun's disc till about four seconds later. At the conclusion of the eclipse, the appearance resembled two waves running towards each other along the sun's limb and meeting at the last point of contact. At the instant of meeting the convexity of the sun's border became perfected, and this instant was seized as the termination of the eclipse. It took place at $4^h\ 11^m\ 13^s\!\cdot\!2$ Greenwich mean time. It was my intention to have observed the eclipse in accordance with the systematic directions drawn up and circulated by the Astronomer Royal, but the intervention of clouds prevented this being done to any great extent. The following are all the observations that could be obtained :—

Liverpool Sid. Time. h m s	Instrumental N.P.D. ° ′ ″	Phenomena observed.
9 41 28·7	70 39 34·95	Sun's N. L.
9 42 32·7	71 11 9·50	— S. L.
9 48 4·7	70 39 38·05	— N. L.
9 49 43·7	71 11 11·30	— S. L.
9 51 35·7	70 39 39·30	— N. L.
9 53 0·7	71 11 14·25	— S. L.
9 54 24·7	70 39 41·85	— N. L.
9 55 40·7	71 11 17·35	— S. L.
10 12 36·8	70 54 3·30	South Cusp.
10 13 32·8	44 52·70	North Cusp.
10 15 20·8	39 54·70	Sun's N. L.
10 16 33·8	56 9·80	South Cusp.
10 18 13·8	42 24·40	North Cusp.
10 19 4·8	39 59·60	Sun's N. L.
10 20 15·8	57 34·55	South Cusp.
10 21 19·8	41 39·85	North Cusp.
10 22 4·8	70 40 0·95	Sun's N. L.
12 10 15·2	71 2 34·20	South Cusp.
12 11 31·2	70 44 34·90	North Cusp.
12 15 33·2	0 50·35	South Cusp.
12 17 9·3	50 45·10	North Cusp.
12 18 59·3	40 32·50	Sun's N. L.
12 26 27·3	70 40 33·15	— N. L.
12 28 18·3	71 12 5·00	— S. L.
12 30 21·3	70 40 33·75	— N. L.
12 33 35·3	71 12 5·10	— S. L.

"I was assisted in the preceding observations by Mr. Towson, the scientific examiner of masters and mates of ships in the merchant service for the port of Liverpool. Mr. Towson took charge of the upper microscope, while I made the bisection, noted the time, and read the lower microscope.

B

"At the time of greatest obscuration, the sun was nearly obscured by a sheet of cirro-stratus cloud; the whole heavens presented a dull, sombre appearance, and two or three gentlemen present complained of chilliness, although the thermometer in the shade was as high as 68°, and only 1°·5 lower than at the commencement of the eclipse."

Whitehaven. By Mr. J. F. Miller.

The greatest phase occurred at $3^h\ 3^m$ Greenwich M.T., when about 0·86 of the sun's disc was covered. The moon's edge, on the whole, was well defined, though somewhat serrated towards the sun's lower cusp. The sun's surface was unusually free from maculæ.

	Greenwich M.T.	Dry Bulb.	Wet Bulb.	In Sunshine.
	h m	°	°	°
July 28	1 45	66	62·5	91
	3 15	61·5	59·5	65

Clouds affected the subsequent observations.

On the supposed Period of Revolution of the Great Comet of 1680. By Mr. Hind.

Of the many hundred comets recorded in history, that which has attained the highest celebrity is the famous body which became visible in Europe towards the end of the year 1680. Independently of its vast magnitude and brilliancy, its train of 90° and its nucleus "glowing like burning coals," it is remarkable as having attracted the attention of the great Newton to the subject of comets, the result of which was the discovery of the true theory of these bodies so zealously applied in practice by Halley. But there is one other point connected with the history of this comet which has excited great interest, I allude to the view taken by Halley, and subsequently by Newton himself, with regard to the time of revolution and the identity of the comet with several others of considerable magnitude mentioned in history.

In the *Synopsis of Cometary Astronomy*, published by Halley, we have a statement of the grounds upon which he considered himself justified in announcing the periodicity of the comet, which depend entirely on historical details. He remarked, if any argument could be drawn "from equality of periods and similar phenomena, that wonderful comet which appeared in the year 1680 was one and the same with that of 1106, when Henry I. was King of England: it first emerged out of the sun's rays on Friday, February 16, in the evening, and was seen for a long time afterwards every evening. The star which seemed little and obscure appeared in the south-east. But the ray which proceeded from it *was very clear* and large, shining towards the N.W., as we have it

recorded in the *Saxon Chronicle* by one who seems to have been an eye-witness." This description, says Halley, agrees very well with that of the comet of 1680, both in respect to the length of its tail and also its situation in regard to the sun. He then draws attention to another comet which was seen during the consulate of Lampadius and Orestes, in 531, in the reign of the Emperor Justinian, and is thus recorded by Malala, the author of the *Chronicle of Antioch*, "A great and fearful star appeared in the west, emitting a white beam upwards, which, as it appeared like the flashes of lightning, some called it *Lampadian*; it was seen for twenty days." Malala does not mention the time of the year this happened; and it is evident that Halley had no knowledge of other descriptions, particularly that of Theophanes, who tells us the comet was seen in September.

Again, it was remarked by Halley, that if we reckon backward another period of 575 years, we shall come to the 44th year before the Christian era, when, soon after the death of Julius Cæsar, a very remarkable comet appeared, mentioned by almost all the historians of those times, and by Pliny in the second book of his *Natural History*, where we have the words of Augustus Cæsar himself concerning it: "In the very days of my games, a hairy star was seen for seven days, in that part of the heavens which is under the *Septentriones*; it arose about the eleventh hour of the day, and was clearly to be seen all over the world." The games here alluded to were dedicated to Venus, and commenced on the 23d of September, the birth-day of Augustus Cæsar. Halley understands by "the Septentriones," the seven bright stars of *Ursa Major*, popularly termed "*Charles' Wain*;" and instead of the eleventh hour of the *day*, he substitutes the same hour of the night, or about four o'clock in the morning at Rome: then, he considers that the description of Augustus is fully represented by the elements of the grand comet of 1680, supposing it to have been in perihelion about the 18th of September.

Thus far Halley endeavoured to trace the history of the comet in past times, and so well convinced he appears to have been of the accuracy of his conclusions, that he gave, at the expense of a great amount of time and labour, a table to facilitate the calculations relative to a comet revolving round the sun in 575 years.

But some writers have attempted to trace the comet into more remote antiquity. Adopting the periodic time assumed by Halley, they consider it must have appeared about 618 years before the Christian era, and refer to that epoch the comet mentioned in the *Oracles of the Sybil*, and even imagine that the prophet Jeremiah, in his first vision about this time, may have beheld the same body, which was to be a sign of forthcoming events. Reckoning backward another period of 575 years, they are able to bring in the lost Pleiad, Electra, who, being unable to view the sight of the destruction of Troy (B.C. 1194), abandoned the company of her sisters and retired towards the north pole of the world, where she appeared a long time in tears and dishevelled hair. This fable our

authors think may have had its origin in the appearance of a great comet, which moved from the Pleiades to the north pole,—a track perfectly accordant, they say, with that of the comet of 1680, under certain conditions. And further, the words of Varro, in relation to the planet *Venus*, which is stated to have changed its colour, figure, and path, about the time of the Deluge of Ogyges, are referred to a comet, which is found to accommodate itself to that of 1680, as regards the year of appearance (about B.C. 1770), and great brilliancy. The fanciful notions of Whiston relative to this comet, its agency in causing the universal deluge and final destruction of the earth, are too well known to require mention here.

My object in the present remarks is to show that neither *history nor calculation* will support the presumed periodicity of the comet of 1680, and had Halley been in possession of the various accounts of the ancient comets which have been collected together since his time, it is tolerably certain that he would never have started his hypothesis. His conclusions were perfectly justifiable on such data as he possessed; and it is necessary to say thus much that my reasons for offering these observations may not be misunderstood.

The descriptions which are left us of the comet observed in the time of Augustus Cæsar and in the reign of Justinian are so vague that they may be satisfied by twenty different orbits, and hence no trustworthy conclusions can be obtained from them alone. The account of the comet of 1106 is much more definite, though still far from perfect; and it is to this year that we must have recourse, to test the Halleian period of the great comet of 1680. If the positions of 1106 are found irreconcileable with the elements of this body, the main foundation upon which the period rests will be destroyed; and as no other large comet is mentioned about that year, we shall be compelled to admit that history is hardly confirmatory of the revolution assigned by Halley and Newton. And our doubts on this point will be still further increased if there should exist any difficulty in reconciling the vague relations of 531 and B.C. 44 with the orbit of the comet of 1680.

Nearly a century ago, Mr. Dunthorne communicated to the Royal Society an extract from a Latin manuscript then preserved in the Library of Pembroke Hall College, Cambridge, relative to the comet of 1106, which is the first on Halley's list. It is there stated that the comet was seen at the beginning of the sign *Pisces*, the tail extending to the beginning of *Gemini*, on the last night of *June* (or, as Mr. Dunthorne reads, *Jumedi*), in the year of the Hegira 499, on a *Wednesday*. It followed the order of the signs until it arrived at the commencement of *Cancer*. In justification of the correction which Mr. Dunthorne has applied to the date, he remarks that the last day of *June* fell on *Saturday* in 1106; but the last day of the Arabic month *Jumedi*, J. occurred on a Wednesday, the day stated in the manuscript. Supposing the comet of 1680 to have reached its perihelion on February 4, "for it must *have been* seen two or three days after it had passed that point,"

Mr. Dunthorne computed some places of the comet, and thought the comparison of them with the manuscript account must lessen, if not quite overbalance, the probability of the identity of this comet with that of 1680.

It is one characteristic of the elements of the latter body that *in less than five minutes* after its perihelion passage the latitude becomes *north*, and must remain so until about 25 days before another perihelion is passed; consequently, the latitude is a most important test of the identity of this comet with any other recorded in history; and it is from a contradiction in this respect that I think the strongest evidence against Halley's supposition is adduced. It will tend to facilitate a clear understanding of the case if the principal circumstances related of the comet of 1106 are collected here.

On the 4th of February in that year, or, according to others, on the 5th, a star or comet was visible in full daylight, from the third until the tenth hour of the day, and was distant from the sun only "one foot and a half," as historians express it. Matthew Paris and Matthew of Westminster are particular in terming this object a *comet*, though it is called a *star* in the Belgian Chronicle, and by several French authorities.

On the 7th of the same month a comet was discovered in Palestine at the commencement of the sign *Pisces;* it was seen in that part of the heavens where the sun sets in winter (*i.e.* about the W.S.W. point of the compass), the tail extended to the beginning of *Gemini*, *below* the constellation *Orion*. The latitude at this time was, therefore, undoubtedly *south*, or the train could not have had this direction. The fact itself is mentioned by two historians. On the 10th, the Chinese saw the comet at the *end* of the sign *Pisces* with a tail 60° long. About the 16th or 18th of February it was more generally observed. It had passed from the southern to the western part of the heavens, and was full west soon after sunset. After some time, it appeared between the west and north with a tail extending towards the north-east, and was visible until midnight. For *twenty-five* days it shone in the same manner at the same hour, and seemed to have no other movement but that of the sun, which gives it a real motion from west to east. The Chinese saw it traverse the constellations, or rather sidereal divisions *Kouei* (commencing at ζ *Andromedæ*), *Leou* (at α *Arietis*), *Mao* (at η *Tauri*), and *Pi* (at ι of the same constellation); in other words, it passed from the end of *Pisces* to the end of *Taurus* before it was lost to view. Historians differ as to the time it remained visible, some assigning a duration of little more than a fortnight, while others, and by far the greater number, extend the period of observation to 40, 46, or 50 days, until it was seen with difficulty (with the naked eye).

Now, to bring the comet to the *end* of the sign *Pisces*, on February 10, as it was observed in China, we must fix the perihelion passage with the elements of 1680 on the 4th of the same month; but here we meet with a difficulty which in my idea is

sufficiently conclusive against the identity of the comets of 1680 and 1106. On the 7th, when it was observed in Palestine, the tail was observed to extend *below Orion*, the head appeared in the W.S.W., and the latitude, as already remarked, must have been *south*, but the comet of 1680 *cannot* have a south latitude at this interval after the perihelion passage. Again, we meet with another objection in a circumstance mentioned by an anonymous author quoted by Struyck, who says the comet advanced to the beginning of *Cancer*, which will not agree with the path calculated from the elements of 1680. These facts argue strongly against the identity of the comets, especially the difference of latitude,—an insurmountable objection. To reject the testimony of ancient historians for the sake of maintaining a preconceived notion on this point, would surely be unjustifiable, particularly when all the observations we possess may be faithfully represented by an orbit, though widely different in its elements from those of the comet of 1680. After the experience we have had in the case of the great comet in March 1843, it cannot be doubted that the "star" seen so close to the sun on the 4th of February, 1106, was really the comet which became conspicuous in Palestine on the 7th of the same month. Pingré, it is true, expresses doubts on this point, but at the time he wrote the visibility of the comet of 1106, only a few degrees from the sun's limb, was without a parallel in the history of cometary astronomy. The grand comet of 1843 was discovered in full daylight and less than three degrees distant from the sun, on the day of perihelion, in Italy, in America, at the Cape of Good Hope, and other stations.

Let us now examine the few particulars which have reached us us respecting the comet mentioned by the historian Malala, A.D. 530 or 531, which Halley considered also identical with that of 1680, I say 530 or 531, for the fact is, there exists some doubt as to the year the comet was observed. Cedrenus places it in the fourth year of Justinian which appears to be 530, while Zonaras in his *Annals* defers it until the fifth year of Justinian, therefore till 531. The comet mentioned by the European historians was visible in the evenings in September in the western heavens, the tail extending upwards towards the zenith, in which case it could not have been that of 1680, which can only be observed in the mornings during the autumn. Father de Mailla tells us that the Chinese observed a comet in the 9th moon of the 47th year, 54th cycle, or in October 530, adding, that it was observed from *Arcturus* to λ and μ *Ursæ Majoris* (from *Takio* to *Tchong-tai*), a remark which may either refer to the direction of motion of the head or to the direction of the tail. This last I consider most probable, as we meet with other instances of a similar kind in the Chinese accounts of comets. In a paper upon the past history of Halley's comet, presented to this Society in January 1850, I have shown that the Chinese comet of October 530 might, very probably, have been Halley's, if De Mailla's remark refer to the tail; this author was no great astronomer, and his descriptions are frequently much confused from want of a proper

understanding of the difference between the Chinese asterisms and sidereal divisions. Pingré, in his *Cometography*, distinguishes the European comet of 531 from the Chinese comet of 530, adding that the relation of De Mailla will not agree with the account furnished by Theophanes and other Europeans, though it accords well with the theory of the comet of 1680, supposing it to refer to the movement of the head; and hence he thinks the Chinese and European comets were different bodies, and that the former may have been identical with the great comet of 1680. I confess I do not see this in the same light. It appears more natural to conclude that the same body was observed in Europe and Asia, an error of a year being admitted in one relation, probably in the Chinese; and I think Pingré's objection to this inference may be overcome by allowing the various particulars to refer to different dates, the Chinese observing the comet when it was, perhaps, not very favourably situated for Europeans. It is useless, however, to reason upon such vague accounts, and I shall merely add that orbits entirely different from each other will agree equally well with the few particulars that have descended to us respecting the comet of Malala.

The comet of Augustus Cæsar is liable to equal uncertainty. In the same year, but in June instead of September, the Chinese observed a comet in the north-west, with the same right ascension as the constellation *Orion;* and it is certain if this be the object mentioned by Augustus Cæsar, it could not have been the comet of 1680. But there is a probability in favour of the appearance of two comets in B.C. 43, the first being that of the Chinese historians, and the second the comet of Augustus and the "unknown star" of Dion Cassius, which shone for a long period. Now, the only one which affords the slightest indication of identity with the comet of 1680 is that of Augustus, and in order to make this identity plausible, M. Pingré has suggested several alterations or different interpretations of the original for which it is not easy to admit the necessity. His discussion will be found in the second volume of the *Cometography*, p. 138, but after all this able astronomer remarks that the circumstances, thus revised or altered, would accord as well with the elements of a great number of other comets, as well as with those of the comet of 1680. Even supposing, therefore, that it is possible to reconcile the description of Augustus Cæsar, under the original interpretation, with the orbit of that comet, it affords but very doubtful evidence in favour of identity, since a dozen other comets might have been viewed under the same circumstances. Dion Cassius particularly mentions that the "unknown star" was visible a long time, and on this account it seems not unlikely that it may have been the same as Cæsar's comet, and the comet of the Chinese; in which case its identity with the comet of 1680 is out of the question.

Thus far then we have the testimony of history. But as I have already remarked, calculation is against the truth of the Halleian period of the comet, that is, the discussion of the observations taken in the years 1680 and 1681 leads to results which cannot

be reconciled with it. In the *Zeitschrift für Astronomie* for 1818 is a remarkable memoir upon the comet of 1680, published without name, under the motto "*Et voluisse sat est*," but due to Professor Encke, then of the Seeberg Observatory, and now the well-known astronomer of Berlin. It is impossible to speak in too high terms of the execution of this elaborate paper, which contains an accurate reduction of all the observations, and a rigorous computation of the most probable elements of the comet's orbit, in which the author has availed himself of all the appliances of modern science. Before stating the conclusions arrived at in this memoir, it will be desirable to give a brief recapitulation of the circumstances connected with the apparition of the wonderful comet of 1680.

Godfrey Kirch, of Coburg, in Saxony, was the first discoverer of this body, which he met with on the morning of the 13th of November, as he was about to observe the moon and planet *Mars*. There were several small stars in the field of the telescope with the comet, and he determined its position by estimation with respect to them. The observation is a very fair one, the stars of reference were all situate within a space of little more than a degree, and their places are found in the *Histoire Céleste* of Lalande. Encke considers that the resulting position of the comet is uncertain to the amount of 90 seconds of arc only; and any one who will take the trouble to lay down the places of the comet and stars upon paper, and then read over the observations of Kirch as detailed in the *Philosophical Transactions*, vol. xxix., must, I think, readily admit that this is as large an error as a careful observer would be likely to make. It is necessary to be satisfied upon this point, because the first observation by Kirch has an all-important bearing upon the determination of the true form of the comet's orbit. Observations were taken by the same astronomer on the mornings of the 16th and 21st of November, but they are too rough to be of service. The same remark applies to nearly all the observations taken elsewhere before the perihelion, including those of Ponthäus, Cellius, Gallet, Montenarus, &c. The comet was detected by Flamsteed, at Greenwich, on the 22d of December, and was observed by him fourteen times between that date and the 15th of February. Cassini observed it on eight evenings during the three weeks following the 29th of December. The latest positions were obtained with great care by the illustrious Newton between the 7th and 19th of March. In addition to the observations of Kirch, Flamsteed, Cassini, and Newton, which possess a considerable degree of accuracy, a great number of others were taken in 1681, in various parts of Europe and America; but with few exceptions they are extremely rough and of no service in the investigation of the elements.

In the memoir to which I have alluded, Professor Encke first deduces an approximate set of elements from five observations reduced by Halley, including the first by Kirch, three by Flamsteed, and the latest by Newton on March 19. He then rigorously reduces the whole series of positions by Flamsteed, Newton, and

Cassini, and determines the effect of planetary perturbations upon the geocentric places of the comet, having regard to the influence of *Mercury*, *Venus*, the *Earth*, *Mars*, *Jupiter*, *Saturn*, and *Uranus*. It is found that at no time during the visibility of the comet was its apparent position affected by perturbation to the amount of one second of are. The next step is to deduce equations of condition for small variations of each element for the whole series of observations, including the early one by Kirch, and these equations are finally solved by the method of least squares. The result shows that the most probable period of revolution is 8814 Julian years, but that the observations may be represented within their probable errors by elements in which the extremes for the time of revolution are 6179 and 14,031 years, that is, it cannot be less than the former nor more than the latter.

The next step in the investigation is to ascertain how an ellipse with the Halleian period of 575 years would increase the errors; and for this purpose the equations are again solved, and the following important conclusions are obtained. The sum of the squares of the errors is four times as great as in the former solution, and the first observation by Kirch, which here becomes the *experimentum crucis*, cannot be represented within 10 minutes of arc, though $1'\frac{1}{2}$ is a fair allowance for its possible uncertainty; an error of 10′ is out of the question. Here then we have the results of calculation decidedly opposed to the Halleian period of revolution.

Professor Encke next finds the most probable parabola, which agrees very well with the observations, and after computing the elements on the hypothesis of hyperbolic motion, though without a satisfactory result, the errors being as large as with Halley's period, he proceeds to determine the most likely orbit and its probable limits, from the observations of Flamsteed and Newton only; he finds that the time of revolution which best satisfies the whole is 3164 years, but that these positions may be represented within their probable errors by orbits in which the period may be any length of time greater than 805 years. But when we come to compare the elements with Kirch's first observation, the agreement is not so good as in the former case, where all the equations were solved together. Professor Encke arrives at the conclusion that it is impossible to assign by calculation the exact period of revolution of this famous comet; but, he remarks, there is the highest probability against its being less than 2000 years. The most legitimate assumption which the researches of this great astronomer enable us to make, is that the revolution of the comet is accomplished in a period somewhere between 6000 and 14,000 years.

It is worthy of remark that in the case of a comet with a revolution of many centuries, it is very improbable that several successive periods between the perihelion passages should be equal within one or two years. It is almost certain that in an orbit so excentric as that of the comet of 1680, planetary perturbations would greatly alter the successive periods; for, as Encke shows, notwithstanding the small effect of these disturbances upon the geocentric

place, their influence upon the major axis is very considerable, owing to the enormous excentricity and the smallness of the parameter. Even in the three months following the perihelion passage of the comet of 1680, its period, supposing it to have been 575 years at this epoch, would have increased by nearly five years, and in a whole revolution the difference might be vastly greater.

I think any person who impartially reviews the evidence of history and calculation, which is here collected together, must be led to the conclusion that the Halleian period of the great comet of 1680 cannot be admitted. I have been the more anxious to submit these observations to the Society, inasmuch as, s far as I am aware, the particulars are not at present to be found in any English work, and it seldom happens that an elementary treatise on astronomy issues from the press without a repetition of the old story respecting this comet, which is frequently given in the most positive terms, and arguments founded upon it which can have no pretensions to accuracy or even plausibility. It is no compliment to either Halley or Newton to suppose that if the historical and other evidence now in our possession had been before them, they would have started the hypothesis of a periodic revolution of the comet of 1680 in 575 years.

On a Method of converting the Motion of a Pendulum-clock into an equable Motion of Rotation. By Mr. R. L. Jones, F.R.A.S.

I have for some time been endeavouring to make a cheap and accurate clock for moving an equatoreal telescope, and I think I have perfectly succeeded.

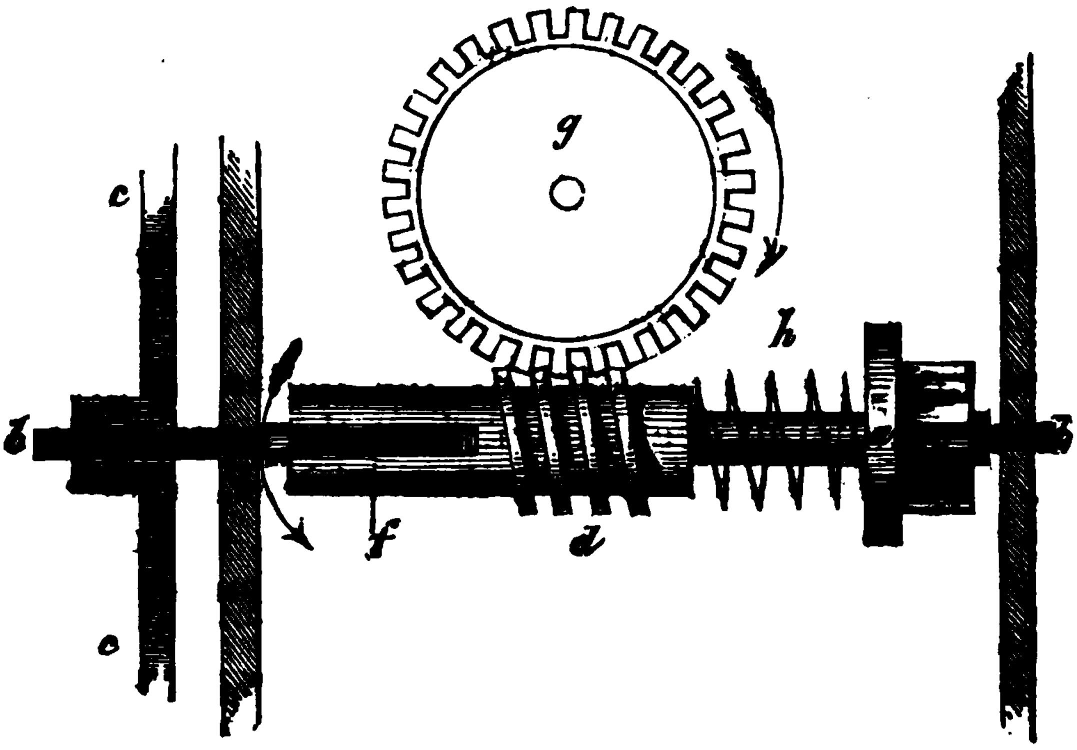
The principle proposed was that of governing the time by an ordinary pendulum, and equalising the motion by a fly-wheel. A spring has been used for this purpose by others, but I am not aware that it has been applied in a manner similar to mine.

The power is obtained by a weight suspended by a catgut cord, a little thicker than that of a common clock, and which is wound on a barrel $3\frac{1}{2}$ inches diameter. Attached to this barrel is a toothed wheel, with which another wheel works that is keyed on the axis of the tangent-screw; this carries the telescope in the ordinary way.

The barrel turns four times in the hour, and requires winding once in three hours, but might be made to go considerably longer without difficulty. From the wheel attached to this barrel there is a series of wheels and pinions to gain speed, and the last pinion revolves once in a second; the fly-wheel, which is very light, but 12 inches diameter, is keyed to the axis of this pinion. On the same axis is a tangent-screw, which, by means of a slot, and a pin through the axis, is free to slide along the axis, but must turn with it. The tangent-screw turns a wheel with thirty teeth, giving it one revolution in 30 seconds. On the same axis with the last-named

wheel, is an escape-wheel of thirty teeth, which works the escapement, and a pendulum of the length to beat half-seconds.

The parts last described require a sketch.



(Full size.)

a The last pinion of the series.
b Its axis.
c A portion of the fly-wheel.
d The tangent-screw.
f The slot and pin.
g The wheel on the same axis as the escape-wheel.
h A spiral spring of thin brass wire.

When the motion of the wheel *g* is suspended by the escapement, the continued motion of the fly-wheel and axis forces the tangent-screw to the right, compressing the spring. When the wheel is unlocked, the spring returns the tangent-screw to its former place and moves the wheel *g* one tooth.

It is evident the only irregularity in the motion of the fly-wheel arises from its having once in each revolution to compress the spring; but for the purpose of keeping the pendulum in motion the spring is required to exert a very small recoil force, and it is compressed to an extent equal only to the breadth of one tooth of the wheel *g*: the effect of this cannot be noticed.

Any tendency in the fly-wheel to increase its speed beyond what is needful to move one tooth of the wheel (*g*) in each revolution, is controlled by its increased pressure on the spiral spring.

The weight required to work the clock and the telescope is 16 pounds; the telescope is 6 feet focus with a clear aperture of 4 inches. From a number of experiments I should say the power is divided as follows:—

	lbs.
To carry the telescope	1
Pendulum	2
Fly-wheel	11
Friction	2

When the telescope is tolerably poised, the power to drive it is

so small a portion of the whole, that a little inequality in the poise or a moderate wind has no sensible disturbing effect. The clock will gain or lose a little as the power alters the arc of vibration of the pendulum; but this will not be much, and may, perhaps, be sufficiently compensated by adopting a scapement between the recoil and dead beat.*

Observations of the Satellites of Uranus, made with the 20-feet Equatoreal. By Mr. Lassell.

"In the first column of positions, the angles are given with reference to the parallel of declination, from the north point round by east; and, in the adjacent column, the positions are approximately reduced to the angles on the apparent orbits, reckoned from the ascending node round by north in the direction of the motions of the satellites.

"The proportion of the transverse axis to the conjugate, as the orbits are at present projected, is nearly as 8 to 6, and the inclination to the ecliptic is about $82°\frac{1}{2}$ s. p. and n. f.

"In every instance the positions and distances of (1) and (2) are the results of *estimations*,—generally from the *measured* positions and distances of the two bright satellites. And the first two satellites discovered by Sir Wm. Herschel in 1787, usually termed "the 2d and 4th," or "the bright satellites," are here designated by the Roman numerals III and IV.

	(1.)			(2.)			III.		IV.	
	Positions.			Positions.			Positions.		Positions.	
Green. M.T.	Paral[l].	Orbit.	Dist.	Paral[l].	Orbit.	Dist.	Paral[l].	Dist.	Paral[l].	Dist.
1851.	°	°	"	°	°	"	° ′	"	° ′	"
Oct. 24·4375	163	275	...	354	77	...	168 26	30·83	156 11	39·92
28·5	325	115	...	350	84	...	358 0	29·92	33 0	...
30·4791	35	30	10	169	268	...	268 9	23·28	350 23	40·99
Nov. 2·5	320	121	12	273	163	13·8	160 43	28·91	272 47	29·39
12·4375	332	106	...	131	311	...	112 34	...	5 0	...
17·4375	337	101	...	47	19	...	257 34	24·09	220 12	34·63
18·5	186	242	...	316	126	...	202 0	...	191 6	36·83
21·4889	123	318	...	63	7	...	91 7	21·38	131 57	34·29
22·4833	332	106	...	329	111	...	38 50	26·03	101 32	...
27·4798	345	91		not seen			194 25	18·61	325 31	38·12
Dec. 11·3750	150	291		not seen			340 0	...	304 0	...
16·4132	160	280	13·5	70	0	14	147 0	...	172 19	...
22·3541	...	...	...	...	...	...	248 26	...	10 2	39·46

Observations and Remarks.

Oct. 24. Sky pretty favourable; the new satellites (1) and (2) seen certainly for the first time.

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* In extreme cases, the pendulum might be suspended from a string between *cycloidal cheeks*, as in Huyghens' clocks.

Oct. 28. The sky had only recently cleared at $11\frac{1}{2}$ hours, after a rainy and stormy evening; and though the new satellites were certainly seen, the opportunities afforded between the passing clouds only sufficed for a careful diagram of situations, and a single measure in distance of Satellite III.

Oct. 30. An exceedingly faint star was noticed, distant about $3\frac{1}{2}'$ and position about $150°$, but no opportunity occurred of ascertaining whether it was or was not a satellite The measures of the old satellites good and satisfactory.

Nov. 2. Sky stormy and many clouds passing, with a disturbed, though transparent, atmosphere. Exactly at midnight (2) was in the line joining the centre of *Uranus* and IV, and at rather less than half the distance of IV from the planet. At a later period of the night it had evidently passed that line of conjunction.

Nov. 12. Sky hazy, and the faint satellites seen only with great and painful attention. No *measures*, except a single one of III in position, could be got.

Nov. 17. Very keen frosty wind; air indifferent, yet the measures, laboriously taken, are, I think, good. No other stars around *Uranus* at all likely to be satellites. I surveyed the planet some time, with a wheel of, I believe, very excellent concaves, made for me by Mr. Andrew Ross; principally using powers 540 and 351, as they seemed most efficient: but the faint satellites scarcely could be recognised with them, and certainly they were much less evident than with the positive Munich eyepiece 614, or the (Ross) Huygenian 778. I cannot, therefore, corroborate the impression that concaves are more luminous than other eyepieces, in a trial which I should almost think an *experimentum crucis*. I tried the various powers of the wheel up to 2300; and on other occasions I have made desultory comparisons with concaves, leading to a similar result. They perform best when the powers are low.

Nov. 22. At $9^h\ 30^m$, (2), generally the faintest, is nearly in conjunction with (1), or rather a little in advance of the right line joining (1), and the centre of the planet. Atmosphere variable and frequently hazy; but the measures obtained are worthy of confidence. On this occasion the full aperture of the telescope was more efficient than any reduced aperture in facilitating the measures of both positions and distances.

Nov. 27. Measures pretty good, though I was unable to obtain a certain view of (2), the faintest. On calculating afterwards I found that it would be then at about its nearest approach to the planet.

Dec. 11. The air so exceedingly unfavourable that I could only make a diagram of the situations of three of the satellites, (2) being again invisible.

Dec. 16. All the satellites well seen for a short time, but clouds coming on prevented more than a careful diagram being made, and a single measure of IV being obtained; III and IV equal in brightness, (1) very decidedly fainter, yet brighter manifestly than (2).

Dec. 22. Vision very indifferent, yet the measures, carefully taken, are, I believe, good.

"The most probable periods of revolution I have been able to deduce for the new satellites from this series of observations are, $2^d\ 12^h\ 18^m\ 58^s$ for (1), and $4^d\ 3^h\ 33^m\ 26^s$ for (2). With these data I have been led to look back to the observations I made of suspected interior satellites in 1847, and published in the *Monthly Notices*, vol. viii. p. 44, but, by a typographical error, headed 1848 instead of 1847. On reference to the original observations and diagrams, from which the angular positions were deduced, I find that a position-angle of $350°$ on the 14th September better suits the diagram than $10°$. Also, that the observation of 29th September is very questionable, there being only a rude diagram made, without any confirmatory remark appended: I therefore

reject it. But the night of the 6th November was remarkably fine, and a very careful diagram was made of the four satellites in respect to position and magnitude; and remarks are appended which sufficiently attest the correctness and certainty of the observations. I find, however, that the diagram has not been correctly translated into angular positions; and, rejecting altogether the observations of the 29th September, a table of the series will stand thus,—

	(1.)		(2.)		III.		IV.	
	Positions.		Positions.		Positions.		Positions.	
	Parall.	Orbit.	Parall.	Orbit.	Parall.	Orbit.	Parall.	Orbit.
1847.	°	°	°	°	°	°	°	°
Sept. 14·567	350	84						
27·408	326	114						
Oct. 1·521			348	87				
Nov. 6·429	346	89	126	315	292	148	344	92

"Presuming that on the 6th November, 1847, I obtained undoubted observations of the four satellites,* and that (1) was observed on the 14th and 27th September, and (2) on the 1st October, the respective periods given by comparisons of these observations agree with the recently deduced periods within very small limits of error. And comparing the observation of 6th November, 1847, with that of the 2d November, 1851, interval = 1457·071 days, and concluding that 580·114 revolutions of (1) took place in that interval, I obtain for its period 2·5116998 days, or $2^d\ 12^h\ 16^m\ 50^s{\cdot}86$. In like manner, concluding that 351·5694 revolutions of (2) were performed in the same time, its period comes out 4·144477 days, or $4^d\ 3^h\ 28^m\ 2^s{\cdot}91$.

"In October 1847 I estimated the proportions of the axes of the orbits to be as 10 to 5·15, and that the major axis was inclined to the ecliptic $87°\frac{1}{2}$."

* *Verbatim Copy of the remarks entered in my journal, under date 6th November, 1847, with a tracing of the diagram contained therein.*

Uranus $9^h\ 35^m$ M.T.

"The most distant about six diameters, the other about three. The closest satellite observed at $10^h\ 20^m$. There is no question whatever of its visibility. Though fainter than the next, perhaps from its closeness to the planet, distant about two diameters, barely. A still closer satellite following, detected at $10^h\ 50^m$: by much the faintest, but yet undoubted. At $11^h\ 30^m$ the satellites retain nearly the same position with respect to *Uranus*, which proves them to be satellites, as the planet would otherwise have left them behind. I have been repeatedly interrupted by thin clouds, and they are now again forming, so that I fear I shall not get a measure. I think the faintest satellite is distant $1\frac{1}{2}$ diameter, and that the next is something more than two. $11^h\ 40^m$, it has become completely cloudy.

West.  East.

Observations of Neptune and his Satellite. By Mr. Lassell.

1851.	G.M.T. h m	Position. ° ′	G.M.T. h m	Distance. ″
Aug. 29	12 0	218 35	12 0	15·14
Sept. 15	11 30	210 9		
Oct. 16	10 15	232 26	10 15	11·25
24	8 22	41 13	8 2	15·60
Nov. 17	7 30	44 52	7 30	13·58
22	6 21	34 26	6 38	13·27

Observations and Remarks.

Aug. 26. Sky very variable, sometimes brilliant, and sometimes almost entirely overcast. Wind violent from about west. Turned to the planet about 11^h. I thought the view remarkably good for the circumstances. Power 219, with which the satellite was immediately seen, and an evident appendage, such as I used to take for a ring, but more evident on the south side, nearly at right angles with the parallel of motion. The same appearance remained with 366, but scarcely so strikingly, and it vanished with 614. At this time I was observing with the new speculum (C), mounted with the system of levers I have elsewhere described (see *Monthly Notices*, vol. xi. p. 165), which totally removes the indications of flexure formerly discernible. I had also, with power 614, a strong suspicion of a second satellite, but though I saw a point there positively for a short time, I could not afterwards see it. The sky, however, was very variable, and clouds and haze coming on prevented my obtaining any measures, even of the known satellite. Estimated position of satellite 40°; position of suspected satellite, 145°; rude estimation of distance of suspected satellite, 8″. The position of the axis of the suspected ring is in the direction of 5° and 185°.

Aug. 29. I received again an impression of a ring-like appendage, but it is principally on the south side, and is nearly at right angles to a parallel of declination. The measures taken to-night are worthy of confidence.

Oct. 16. Sky very unfavourable, and frequently obscured by passing clouds. Measures obtained with great difficulty.

Oct. 24. Measures remarkably good and satisfactory.

Nov. 17. Air pretty good, and measures very satisfactory.

Nov. 22. Wind north, and sky brilliant, but the planet very ill defined, and measures were taken with great difficulty. Air decidedly bad. Yet, on turning the telescope at a later hour upon *Uranus*, I saw the faint satellites almost immediately; and I received quite a different impression of the quality of the air. The improvement is probably chiefly owing to the difference of altitude; for I scarcely ever remember seeing an object with the 20-foot telescope and a power of 600, (which is necessary for coping with *Neptune's* satellite,) without being, even at the present meridian altitude of that planet, greatly annoyed by atmospherical disturbances.

Divisions of the Ring of Saturn. Extract of a note from Mr. W. C. Bond.

On October 20th, 1851, the broad inner ring of *Saturn* was seen to be divided into a succession of narrow rings for two-thirds of its breadth, the dark stripes being most conspicuous on the side of the ring nearest the ball. Much in the manner described by Mr. Dawes (*Monthly Notices* for November 1851). The state of the atmosphere was unusually favourable, so that, even with a power of 800, the minute subdivisions were quite apparent. Attention was not directed to the outer narrow ring; but with a power of 140 no new division was noticed.

Note on the Dark Ring of Saturn. By Mr. Dawes.*

In the year 1838, Dr. Galle, with the large refractor at the Berlin Observatory, discovered the luminous portion of the faint ring, and on four different nights measured its breadth from the inner edge of the bright ring. But as the phenomenon was not seen by any other observer, or its real nature completely made out, the discovery attracted little or no attention on the Continent, and seems to have been entirely unknown both in this country and in America. Subsequently, the great southern declination of the planet precluded advantageous observations of it in these latitudes; and thus Galle's discovery remained unconfirmed for twelve years.

The astronomical instruments of the late Mr. Children are to be disposed of; they are in good condition, and may be seen at the apartments of the Royal Astronomical Society.

A very fine equatoreal with clock-work, the telescope about 66 inches focal length, aperture 4 inches: the object-glass by Mertz, and the mounting by Troughton and Simms.

A 30-inch transit and iron stand by Troughton and Simms.

An 8-inch altitude and azimuth by Troughton and Simms.

Two level collimators by Troughton and Simms.

A large microscope by Dollond, and a diploeidoscope by Dent.

ERRATA

In the early copies of the January Notice.

Page 43, line 19, *for* Colonel Silverstopfe, *read* Silverstolpe.
— 45, last line, *for* 70°, *read* 45°.
— 46, line 1, *for* 100°, *read* 80°.
— — — 2, *for* 145°, *read* 110°.
— 47, — 34, *for* RINGERIGEL, *read* RINGERIDET.
— 49, — 29, 31, *for* JUNE, *read* TUNE.
— 64, — 42, *for* $3^h\ 56^m\ 54^s{\cdot}9$, *read* $3^h\ 55^m\ 54^s{\cdot}9$.
— 66, — 18, *for* RAVELSBERG, *read* RÆVELSBERG.
— 67, 2d line from bottom, *for* 22 inches, *read* 20 inches.
— 72, line 30, *for* Colonel Silverstopfe, *read* Silverstolpe.
In plate, *for* 11, *read* 14.

Monthly Notices, vol. x. p. 173, B.A.C. 3233 is set down as having a difference in R.A. $= -60^s{\cdot}71$. On a subsequent revision, it appears that B.A.C. 3233 *does not exist*, and that the star taken for it in Lord Wrottesley's list is B.A.C. 3226, which has nearly the same declination, and exceeds it 1^m in R.A.

Vol. xii. p. 61, Observations of MM. Swan and Lane, *read* Lat. 57° 42′ 58″ N., Long. $0^h\ 47^m\ 45^s{\cdot}3$ E.
— — — 62, line 25, *for* group of spots 1′, *read* 1′½.
— — — —, — 27, 28, 29, *for* $3^h\ 8^m$, *read* $3^h\ 58^m$.

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* This note should have been inserted in the last Annual Report, p. 103.

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ROYAL ASTRONOMICAL SOCIETY.

Vol. XII. *April* 7, 1852. No. 6.*

George Bishop, Esq., Treasurer, in the chair.

Wm. Spottiswoode, Esq., 12 James Street; and
Josh. Rankin Stebbing, Esq., of Southampton,
were duly elected Fellows of the Society.

The newly-discovered comet will be found page 166.

THETIS.

On April 17, M. R. Luther, director of the Observatory of Bilk, near Düsseldorf, discovered a new asteroid, the 17th of the group. This planet has since received the name of *Thetis*.

1852.	Bilk M.T. h m s	App. R.A. ° ′ ″	App. Decl. ° ′ ″	No. of Obs.
April 17	*10 37 39	180 38 24	+8 49 2	
20	10 26 28·0	180 12 38·4	8 57 12·0	14
21	10 0 43	180 4 59	8 59 27	
May 5	9 53 26·9	178 56 41·9	9 6 29·2	7
7	9 16 25·9	178 53 34·5	+9 3 49·7	3

Berlin. (Dr. Brünnow and G. Rümker.)

1852.	Berlin M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″	Obs.
April 22	12 11 58·7	179 56 43·6	+9 1 18·7	10
23	10 57 49·3	50 5·7	3 22·7	12
25	12 15 57·0	36 41·9	6 18·2	15
26	11 10 17·3	179 31 4·2	+9 7 18·7	12

Altona. Equatoreal. (Dr. A. C. Petersen.)

1852.	Altona M.T. h m s	R.A. h m s	Decl. ° ′ ″	No. of Obs.
April 25	10 39 55	11 58 28·90	+9 6 6·3	6
26	9 33 22	11 58 9·01	+9 7 6·5	10

Assumed *apparent* place of Star of Comparison, $11^h\ 55^m\ 47^s{\cdot}04$ $+9^\circ\ 7'\ 57''{\cdot}1$.

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* Owing to very serious illness, Mr. Hartnup has not been able to make his usual contributions to the present Number; he is, however, happily recovering.

In the present Number the Editor has included almost all the matter received up to the date of publication.

Altona. Meridian Circle. (M. Sonntag.)

1852.	Altona M.T. h m s	R.A. h m s	Decl. ° ′ ″
April 25	9 42 24	11 58 29·36	+9 6 2·5
26	9 38 4	11 58 5·38	+9 7 7·6

Hamburg. Equatoreal. (M. C. Rümker.)

1852.	Hamburg M.T. h m s	R.A. ° ′ ″	Parx. ″	Decl. ° ′ ″	Parx. ″	Obs.	Star of Comp.
April 23	10 35 13·2	179 50 10·7	+0·7	+9 3 18·0	+4·0	10	Weisse; XII^h, 16, 34
25	11 54 25·2	37 0·4	1·1	6 4·4	4·0	7	1
26	11 6 39·2	179 30 56·4	1·3	7 10·6	4·0	6	1
May 7	13 3 13·9	178 53 21·1	2·9	9 3 34·1	4·1	11	2
11	11 2 26·8	52 22·8	1·9	8 55 50·8	3·8	8	2
15	12 12 23·0	178 58 2·9	2·7	44 39·7	4·0	7	
16	11 40 53·0	179 0 33·3	2·5	41 26·9	4·0	10	
17	9 59 45·7	179 3 8·0	+1·4	+8 38 3·2	+3·8	6	

Mean Places of the compared Stars for Jan. 0, 1852.

No.	R.A. h m s	No. of Obs.	N.P.D. ° ′ ″	No. of Obs.
1	12 0 33·36	1	+9 4 30·9	1
2	11 55 0·80	3	+8 53 42·0	2

Cambridge. Northumberland Equatoreal. (Professor Challis.)

1852.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	No. of Comps.	Star.
April 26	13 20 1·8	11 58 1·89	+8·535	80 52 32·4	−9·8569	3	*b*
27	8 47 34·8	57 44·05	−7·916	51 49·2	9·8332	3	*b*
	9 33 16·1	43·02		53·9	9·8320	Meridian	
May 4	8 50 19·8	55 55·38	−7·392	52 12·2	9·8322	2	*q*
	10 51 39·3	54·19	+8·275	17·8	9·8387	6	*b*
5	10 51 46·5	11 55 45·51	+8·290	80 53 22·6	−9·8392	7	*b*

The star of comparison is Bessel (Weisse), xi^h, 944: Weisse's place is adopted.

Approximate Elements. By Dr. Brünnow.

	° ′ ″	
M	+ 303 57 38·6	1852, April 17·0, Berlin M.T.
π	259 48 29·3	
☊	124 27 33·5	
i	5 37 40·9	
ϕ	7 47 29·1	
Log a	0·402348	
μ	884″·0650	

An ephemeris founded on these elements is omitted.

Rectangular Co-ordinates from Dr. Brünnow's Elements, referred to the Apparent Equinox, April 17. By Professor Temple Chevallier.

$$x = [0{\cdot}3970076] \sin (349^\circ\ 50'\ 44''{\cdot}1 + u) + 0{\cdot}0596252$$
$$y = [0{\cdot}3747225] \sin (261\ 42\ 17{\cdot}5 + u) + 0{\cdot}3179134$$
$$z = [9{\cdot}9515049] \sin (247\ 46\ 19{\cdot}5 + u) + 0{\cdot}1122336$$

Elements.

By M. E. Vogel, of the South Villa Observatory, Regent's Park, from the Observations at Bilk, April 17; Berlin, April 26; Liverpool, May 6.

M	= $306^\circ\ 7'\ 18''{\cdot}33$	May 6, 0^h, Berlin M.T.
π	260 28 28·72	Mean Equinox,
☊	125 45 24·14	1852, Jan. 1.
i	5 35 38·20	
φ	6 24 39·83	
Log a	0·3868301	
Log μ	2·9497615	
μ	932″·74200	

These elements represent the middle observation exactly.

Ephemeris.

At $9^h\ 36^m$ Berlin Mean Time.

1852.	R.A. h m s	Decl. ° ′	Log Δ.
May 18·4	11 56 25	+8 34·2	0·21307
19·4	56 40	30·3	
20·4	56 57	26·2	
21·4	57 15	22·0	
22·4	57 35	17·6	0·22302
23·4	57 56	13·0	
24·4	58 18	8·2	
25·4	58 41	+8 3·3	
26·4	59 6	+7 58·2	0·23298
27·4	11 59 33	53·0	
28·4	12 0 2	47·6	
29·4	0 32	42·0	
30·4	1 3	36·3	0·24296
31·4	1 35	30·4	
June 1·4	2 9	24·4	
2·4	2 45	18·2	
3·4	3 22	11·9	0·25291
4·4	4 1	+7 5·5	
5·4	12 4 40	+6 58·9	

1852.	R.A. h m s	Decl. ° ′	Log Δ.
June 6·4	12 5 20	+6 52·2	
7·4	6 2	45·4	0·26281
8·4	6 45	38·4	
9·4	7 29	31·3	
10·4	8 14	24·1	
11·4	9 1	16·8	0·27263
12·4	9 49	9·3	
13·4	10 38	+6 1·7	
14·4	11 28	+5 54·0	
15·4	12 9	46·2	0·28128
16·4	13 11	38·3	
17·4	14 4	30·3	
18·4	14 59	22·2	
19·4	12 15 56	+5 14·0	0·29176

By M. G. Rümker, founded on the Observations at Bilk, April 20; Berlin, April 28, and May 11.

	° ′ ″	
M	313 25 1·43	May 16·5, 1852, Berlin M.T.
π	259 10 9·11	Mean Equinox, June 0·0, 1852.
☊	125 3 4·63	
i	5 32 55·09	
ϕ	8 30 39·16	
Log a......	0·3963126	
Log μ......	2·9555377	

An ephemeris by M. G. Rümker, founded on the above elements, arrived after M. Vogel's ephemeris had been set up.

PSYCHE.

Dr. de Gasparis' last discovered planet has been named *Psyche*.

CAMBRIDGE. Northumberland Equatoreal. (Professor Challis.)

1852.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$.	N.P.D. ° ′ ″	Log $\frac{q}{P}$.	No. of Comps.	Star
April 8	9 34 51·4	9 50 25·81	+7·933	76 15 56·0	−9·7940	4	*a*
	11 17 36·3	25·06	+8·426	56·7	9·8138	1	*a*
10	10 10 0·1	50 14·51	+8·240	14 5·5	9·8000	7	*a*
12	8 25 2·0	50 9·45		12 41·6	9·7907	Meridian	
13	8 21 4·4	9 50 7·69		76 11 58·7	−9·7906	—	

The planet was very faint on the meridian on April 12. The star of comparison is H.C. 19589, and its adopted mean place for 1852·0, deduced from two transits and one circle observation taken at Cambridge, is as follows:—

R.A. $9^h\ 54^m\ 8^s{\cdot}55$ N.P.D. $76°\ 23'\ 19''{\cdot}7$

Berlin. (Dr. Brünnow and G. Rümker.)

1852.	Berlin M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″
April 20	10 31 13·9	147 38 39·9	+13 48 40·7
21	10 50 14·9	40 53·7	48 21·4
22	10 41 34·1	43 19·5	47 54·8
23	9 45 7·6	45 58·3	47 22·7
25	10 53 46·6	52 31·9	45 53·4
26	10 2 58·2	147 56 4·3	+13 45 6·2

Hamburg. Equatoreal. (M. C. Rümker.)

1852.	Hamburg M.T. h m s	R.A. ° ′ ″	Par^x. ″	Decl. ° ′ ″	Par^x. ″	No. of Comp.	Comp. Star.
April 11	8 58 15	147 32 57·6	+0·3	+13 46 47·6	+2·2	6	1
16	8 46 31	32 52·5	0·3	49 1·2	2·2	6	1
23	8 59 14	46 6·2	0·7	47 33·0	2·1	10	1
25	9 31 8	52 20·9	1·0	45 53·9	2·2	9	1
26	10 16 30	147 56 11·1	1·3	44 59·6	2·2	8	2
May 6	10 15 22	148 47 27·4	1·5	30 46·0	2·2	4	2
7	9 50 13	148 53 55·6	1·3	28 40·4	2·1	4	2
11	10 11 20	149 22 31·8	1·5	20 8·4	2·2	12	2
15	10 58 22	149 55 11·7	+1·5	+13 9 40·6	+1·9	21	

Mean Places of the Compared Stars for Jan. 0, 1852.

	R.A. h m s	Decl. ° ′ ″	No. of Obs.
1	9 49 10·87	+13 51 33·0	2
2	9 58 39·78	+13 30 1·2	1

Rome. Meridian Circle. (Father Secchi.)

1852.	Rome M.T. h m s	R.A. h m s	Decl. ° ′ ″
April 5	8 54 25·0	9 50 52·25	+13 40
6	49 42·0	50 42·55	41 29·7
7	45 37·0	50 33·93	42 40·5
10	33 40·1	50 24·07	45 37·2
11	29 32·2	50 12·11	46 44·6
12	25 33·7	50 9·43	47 15·5
13	21 36·9	50 8·58	
15	13 45·8	50 9·29	48 35·5
18	8 2 8·7	9 50 19·92	+13 49 8·3

With Cauchoix's refractor and circular micrometer.

	Rome M.T. h m s	R.A. s	Decl. ′ ″	No. of Comps.
April 21	8 22 32·5	✱ + 18·63	✱ + 17 38·8	4
23	8 24 8·7	39·56	16 34·5	5
24	9 28 7·2	✱ + 52·44	✱ + 15 47·1	4

Not corrected for parallax.

Apparent Places, by meridian circle, of the Star of Comparison.

	R.A. h m s	Decl. ° ′ ″
April 21	9 50 23·81	+13 31 0·6
24	9 50 23·97	+13 30 59·2

Elements.

By M. E. Vogel, of the South Villa Observatory, from the normal place of March 24, the Cambridge and Liverpool places of April 8, and the Liverpool place of April 24.

M	= 295° 4′ 40″·90	March 24·0, Berlin M.T.
ϖ	244 53 19·03	Mean Eqx,
☊	149 53 32·51	1852, Jan. 1.
i	2 42 15·11	
φ	11 35 18·43	
Log a	0·5254586	
Log μ	2·7418187	
μ	577″·85480	

Calculated—Observed $d\,l$ = +0″·03
$d\,b$ = +0″·01

Ephemeris. By M. E. Vogel.

For 9h 36m Berlin M.T.

1852.	R.A. h m s	Decl. ° ′	Log Δ.
May 16·4	10 0 56	+13 3·5	0·46073
17·4	1 33	+13 0·4	
18·4	2 12	+12 57·2	
19·4	2 52	53·9	
20·4	3 23	50·6	0·46786
21·4	4 15	47·1	
22·4	4 58	43·5	
23·4	5 42	39·8	
24·4	6 27	36·0	0·47485
25·4	7 12	32·1	
26·4	7 58	28·2	
27·4	8 45	24·2	
28·4	9 33	20·1	0·48168
29·4	10 21	15·9	
30·4	11 10	11·7	
31·4	12 0	7·4	
June 1·4	12 50	+12 2·9	0·48833
2·4	13 41	+11 58·4	
3·4	14 33	53·8	

1852.	R.A. h m s	Decl. ° ′	Log Δ.
June 4·4	10 15 26	+11 49·1	
5·4	16 20	44·3	0·49480
6·4	17 15	39·4	
7·4	18 11	34·5	
8·4	19 7	29·5	
9·4	20 3	24·5	0·50108
10·4	21 0	19·4	
11·4	21 57	14·1	
12·4	22 55	8·7	
13·4	23 54	+11 3·3	0·50717
14·4	24 53	+10 57·8	
15·4	25 52	52·3	
16·4	26 52	46·7	
17·4	10 27 52	+10 41·0	0·51305

Mr. G. Rümker has calculated the following Elements on the Naples places of March 19, 29, and the South Villa place of April 4:—

	° ′ ″	
M	280 25 21·5	1852, April 1·0 Berl. M.T.
π	253 56 20·8	Mean Equinox,
☊	150 14 11·7	Jan. 0·0, 1852
i	2 43 8·1	
φ	7 42 56·3	
Log a	0·4965374	
Log μ	2·8052005	

An ephemeris accompanied these elements.

EGERIA.

HAMBURG. Equatoreal and Meridian Circle. (M. C. Rümker.)

1852.	Hamburg M.T. h m s	R.A. ° ′ ″	Parx. ″	Decl. ° ′ ″	Parx. ″	No. of Comps.	Compared Star.
[F]eb. 19	9 52 57·6	184 34 26·7	−3·3	+23 14 37·7	+3·6	4	40
20	9 19 39·3	24 4·7	3·5	19 16·2	3·9	15	40
22	10 24 51·6	184 0 57·4	3·0	30 1·8	3·4	17	40
23	8 58 5·2	183 49 46·4	3·5	34 46·4	3·8	24	40, 41
24	9 2 38·5	37 24·7	3·5	39 50·0	3·8	12	39, 41
25	8 49 42·3	183 24 50·5	3·6	44 33·6	3·8	12	39
27	8 36 40·2	182 58 35·5	3·6	23 53 50·3	3·9	23	38
29	9 30 25·8	30 14·4	3·3	24 2 39·4	3·5	10	35, 37, 38, 39
[M]arch 1	8 54 18·2	182 16 14·6	3·5	6 35·0	3·7	11	37, 38
4	9 14 42·3	181 31 15·3	3·3	17 42·3	3·6	16	33
8	8 30 56·7	180 28 57·6	3·4	29 20·8	3·6	16	32
12	8 23 19·1	179 23 50·3	3·4	37 12·9	3·6	13	30, 31, 32
13	9 35 19·5	179 6 23·9	−2·6	+24 38 36·5	+3·2	14	30, 31, 32

1852.	Hamburg M.T. h m s	R.A. ° ′ ″	Parx. ″	Decl. ° ′ ″	Parx. ″	No. of Comps.	Compared Star.
Mar. 14	12 24 15·0	178 47 54·5	0·0	+24 39 44·0	+2·8	...	Mer. Circle
15	10 28 9·6	178 32 40·4	−1·8	40 21·3	3·6	6	27, 28, 30, and Bess Z. 503, No. 26.
	12 19 13·0	31 15·4	0·0	40 31·0	2·8	...	Mer. Circle
16	8 31 41·2	178 17 28·4	−3·1	40 47·6	3·4	5	28, 30, Bess. Z. 503 No. 26
17	12 9 9·0	177 58 12·2	0·0	41 4·3	2·8	...	Mer. Circle
19	7 55 18·2	28 14·4	−3·3	40 32·4	3·5	5	24, 25, 27
	11 59 6·0	25 19·1	0·0	40 27·1	2·8	...	Mer. Circle
20	8 30 36·3	177 11 24·4	−2·9	39 57·2	3·3	5	25, 27
	11 54 5·2	9 3·4	0·0	39 42·4	2·8	...	Mer. Circle
21	8 23 58·6	176 55 7·8	−2·9	38 54·2	3·3	9	25
	11 49 4·4	52 45·3	0·0	38 45·4	2·8	...	Mer. Circle
22	8 27 54·2	38 57·2	−2·9	37 36·7	3·2	17	25
24	8 19 14·5	176 7 6·2	−3·0	34 12·6	3·3	13	24
	11 34 6·6	5 7·9	0·0	34 6·1	2·8	...	Mer. Circle
25	8 7 2·1	175 51 33·9	−2·9	32 2·2	3·3	6	24
	11 29 7·6	49 18·7	0·0	31 46·2	2·8	...	Mer Circle
28	8 14 43·0	175 5 50·6	−2·6	23 40·3	3·2	12	23, Bess. Z. 353, No. 64
	11 14 18·5	3 49·7	0·0	23 28·5	2·7	...	Mer. Circle
30	8 24 6·0	174 36 41·4	−2·4	16 46·0	3·1	4	23, Bess. Z. 353, No. 64
April 2	9 33 20·9	173 54 36·8	−1·2	24 4 10·2	2·8	13	Bess. Z. 353, No. (
	10 49 57·7	53 19·9	0·0	3 54·9	2·7	...	Mer. Circle
5	10 35 36·6	173 14 52·4	0·0	+23 48 50·8	+2·7	...	Mer. Circle

Mean Places of Stars for Jan. 0, 1852, in the geocentric orbit of *Egeria*, (with which the planet has been compared), deduced from observations with the Hamburg meridian circle.

No. of Star.	R.A. h m s	Decl. ° ′ ″	No. of Star.	R.A. h m s	Decl. ° ′ ″
1	11 12 2·22	+19 53 28·4	23	11 39 20·29	+24 32 29·7
2	12 25·89	21 21 39·8	24	45 13·77	24 36 14·3
3	14 7·58	20 16 59·0	25	46 54·61	24 38 8·8
4	17 19·51	23 27 42·8	26	48 50·22	24 17 50·4
5	18 26·68	20 17 47·9	27	51 29·42	24 43 48·5
6	18 26·99	21 12 46·0	28	52 20·98	24 46 1·8
7	18 41·15	21 20 0·7	29	55 18·90	25 0 4·2
8	19 20·29	20 30 25·9	30	11 56 37·55	24 56 35·8
9	22 21·61	23 25 31·9	31	12 0 29·49	24 31 32·1
10	24 14·96	22 40 35·9	32	0 34·96	24 42 50·1
11	25 5·96	22 48 16·8	33	6 56·93	24 29 23·8
12	25 35·91	22 23 41·8	34	8 50·96	24 46 5·6
13	26 53·33	24 9 58·7	35	10 24·27	23 40 35·1
14	28 55·16	21 12 22·4	36	11 8·76	24 8 20·0
15	30 56·26	23 11 54·6	37	11 7·05	23 56 33·2
16	30 59·81	24 8 53·2	38	11 50·22	23 51 25·5
17	31 8·28	23 36 41·7	39	13 14·24	23 44 13·7
18	32 31·58	22 12 24·1	40	14 56·73	23 17 9·5
19	33 4·94	22 10 26·3	41	15 19·27	23 41 43·7
20	34 46·62	24 43 20·7	42	17 37·20	23 45 6·5
21	*36 4·49*	24 49 52·9	43	12 22 55·08	+23 14 41·9
22	*11 36 53·13*	+23 11 55·4			

FLORA.

HAMBURG. (M. C. Rümker.)

1852.	Hamburg M.T. h m s	R.A. ° ′ ″	Parx. ″	Decl. ° ′ ″	Parx. ″	No. of Comps.	No. of Compared Star, vide infra.
March 12	10 8 6·3	190 32 45·2	−2·5	+5 24 47·2	+4·3	4	18, 20; Weisse, xii, 838
13	10 28 9·0	19 18·6	2·3	33 1·9	4·3	4	15
14	11 7 44·9	190 5 29·6	1·7	40 42·9	4·3	7	15, 16
15	11 6 1·8	189 51 55·1	1·6	48 44·5	4·3	4	15, 16
16	8 56 21·3	39 17·3	3·0	5 55 19·8	4·4	1	15, 16
17	9 16 9·5	189 25 6·5	−2·8	6 3 14·2	4·4	5	15, 16; Weisse, 593; Lalande, 23714
19	8 56 52·6	188 56 46·2	−2·9	6 18 12·7	4·4	6	11; Weisse, 572, 576, 593; Lalande, 23714
	12 44 54·8	54 24·9	0·0	19 23·8	4·2	...	Merid. Circle
20	9 36 59·9	188 41 51·8	−2·5	6 26 2·5	4·3	4	13; Weisse, 572; L. 23692
	12 40 1·6	40 2·6	0·0	26 52·0	4·2	...	Merid. Circle
21	9 14 57·5	188 27 34·0	−2·6	6 33 34·5	4·3	4	Weisse, 572; Lal. 23692
	12 35 7·8	25 30·3	0·0	34 13·7	4·2	...	Merid. Circle
24	12 20 24·2	187 41 27·5	0·0	6 35 52·5	4·2	...	— —
25	9 15 32·7	187 28 39·0	−2·7	7 2 9·7	4·3	4	12; Weisse, 536, 543
	12 15 29·6	26 39·0	0·0	2 53·1	4·1	...	Merid. Circle
28	9 25 6·1	186 43 58·1	−2·7	7 22 44·1	4·3	6	Weisse, 364, 367
	12 0 44·8	42 19·9	0·0	23 8·2	4·1	...	Merid. Circle
April 2	11 36 14·6	185 29 28·9	0·0	7 53 58·1	4·0	...	— —
5	11 22 21·9	184 58 8·2	0·0	8 11 51·3	4·0	...	— —
7	11 11 57·4	184 19 50·5	0·0	+8 20 31·3	+4·0	...	— —

Mean **Places of the Compared Stars and of Stars in the Apparent Orbit of the Planet for Jan. 0, 1852.**

No. of Star.	R.A. h m s	Decl. ° ′ ″	No. of Star.	R.A. h m s	Decl. ° ′ ″
1	12 6 56·94	+5 8 12·3	11	12 32 22·08	+6 15 34·0
2	6 57·15	4 28 46·7	12	33 48·78	7 2 3·9
3	11 49·10	7 49 41·5	13	35 15·43	6 27 27·8
4	17 52·75	8 5 43·9	14	38 46·94	6 20 34·5
5	20 37·33	7 54	15	40 39·60	5 56 43·9
6	22 39·07	6 41 43·7	16	41 54·87	5 58 57·9
7	23 11·30	6 20 4·5	17	44 25·78	5 36 28·9
8	25 58·86	7 2	18	46 8·82	5 2 39·2
9	29 18·47	8 44 52·5	19	46 13·08	5 32 53·9
10	12 30 35·62	+6 26 58·2	20	12 47 51·06	+5 23 57

COMET, 1852, I.

A comet was discovered at Marseilles on May 15, by M. Chacornac, who describes it as "a small and very faint comet, rather diffuse and without tail or nucleus." Its approximate place was, very rudely,

1852.	Marseilles M.T. h m	R.A. ° ′	Decl. ° ′
May 15	14 20	338 30	+66 0
16	15 20	338 0	+68 50

This comet was discovered, *independently*, by Dr. Petersen at Altona, May 17.

ALTONA. (Dr. Petersen.)

1852.	Altona M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″	No. of Obs.
May 17	11 43 24·5	337 55 2·4	+71 13 4·4	4
18	11 20 3·7	337 24 17·2	73 47 5·9	4
19	12 9 40·6	336 39 12·2	+76 33 50·6	4

HAMBURG. (M. C. Rümker.)

1852.	Hamburg M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″	No. of Obs.
May 18	11 48 29·6	337 23 39·6	+73 49 42·6	3
19	11 58 34·0	336 40 10·3	+76 32 44·3	3

BERLIN.

1852.	Berlin M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″	No. of Obs.
May 19	13 4 48·7	336 38 15·6	+76 38 45·5	10

Elements.

By M. A. Sonntag, from the three Altona observations.

T	1852, April 18·6502, Berlin M.T.	
	° ′ ″	
π	280 55 50	Apparent
☊	313 40 22	Equinox.
i	49 8 37	
Log q	9·94938	Motion Retrograde.

These elements have some resemblance with those of 1827, II, or No. 148, in Professor Galle's Catalogue.

Ephemeris.

For Berlin Mean Midnight.

1852.	R.A. ° ′	Decl. ° ′	Log Δ.
May 18·5	337 24	+73 50	9·9191
20·5	335 34	79 9	9·9266
22·5	330 40	84 14	9·9371
24·5	288 35	88 40	9·9501
25·5	196 11	88 9	9·9574
26·5	177 5	86 6	9·9651
28·5	168 57	81 57	9·9815
30·5	166 35	78 3	9·9994
June 1·5	165 31	74 47	0·0179
3·5	164 57	+71 9	0·0368

ENCKE'S COMET.

HAMBURG. Equatoreal. (M. C. Rümker.)

1852.	Hamburg M.T. h m s	R.A. ° ′ ″	Par^x. ″	Decl. ° ′ ″	Par^x. ″	No. of Comps.
Feb. 18	7 43 55·5	0 54 8·7	+4·3	+8 39 58·8	+5·8	10
19	7 20 41·6	1 22 39·6	4·3	8 47 20·3	5·6	7
20	7 11 11·7	1 51 11·4	4·3	8 53 48·7	5·8	17
23	7 17 17·4	3 17 49·8	4·6	9 10 47·7	6·0	20
24	7 17 23·8	3 45 55·6	4·6	9 15 19·6	6·1	9
25	7 49 44·2	4 14 11·1	4·8	9 18 23·0	6·3	4
27	7 5 23·8	5 23 49·6	4·9	9 32 40·1	6·4	5
Mar. 1	7 24 15·5	6 15 55·4	5·3	9 13 43·1	7·0	13
2	7 5 16·4	6 34 46·1	5·5	9 6 58·3	7·1	3
4	7 18 27·6	7 4 31·9	5·7	8 43 25·5	7·4	7
5	7 6 5·2	7 13 50·0	5·9	8 26 31·9	7·7	7
8	7 6 56·5	7 9 52·6	6·3	7 5 56·0	8·2	2
9	7 2 14·6	7 1 36·7	+6·6	+6 45 54·8	+8·7	1

The parallax annexed has not yet been applied. The places of the compared stars have mostly been deduced from the Hamburg meridional observations. See *Monthly Notices*, vol. xii. No. 5.

Apparent Places of the Compared Stars.

	R.A. h m s	Decl. ° ′ ″
Jan. 20	23 12 46·56	+4 34 20·8
	14 29·58	4 31 31·7
22	23 20 42·47	5 15 32·2
	55·02	4 59 30·7
26	23 22 48·81	5 36 31·1
27	23 22 48·81	5 36 31·0
Feb. 18	0 4 10·52	8 18 51·9
19	0 7 46·09	8 55 35·0
20	Idem.	
23	0 12 50·26	9 6 45·0
24	0 12 50·25	9 6 44·9
	19 14·06	19 37·9
	0 20 39·46	+9 22 37·8
Feb. 25	0 19 14·06	+9 12 37·9
	20 39·46	22 37·8
27	0 21 51·23	9 33 54·5
Mar. 1	0 26 29·27	9 29 11·4
2	0 26 29·27	9 29 11·4
4	0 29 56·22	8 49 24·5
	33 32·10	32 39·9
5	0 33 32·09	8 32 39·9
8	0 36 38·81	6 57 31·5
9	0 40 59·07	+6 46 33·2

Description of an Eye-piece for viewing the Sun, &c., with Remarks upon the Solar Spots and other Phenomena. By the Rev. W. R. Dawes.*

The principal peculiarity of this eye-piece consists in a metallic slide, with perforations of different sizes, which crosses the eye-tube

* Mr. Dawes explained the construction of this eye-piece at the meeting, and exhibited drawings of the solar spots as seen by its means. As the memoir will appear in the 4to. volume, a brief abstract is considered sufficient for this place.

at right angles, just at the focus of the object-glass. There are contrivances, which can easily be imagined, for rapid manipulation, and though the slide is, of course, greatly heated when the sun is viewed, the conduction is cut off by interposing a plate of ivory. The perforations vary in diameter from 0·5 to 0·0075 of an inch, and, with a small field, single lenses are preferred to complicated eye-pieces. Mr. Dawes finds that, in general, apertures which exceed 0·3 inch cannot be safely used for a long time under a hot sun. Where the usual proportions are retained between the aperture and focal length of an object-glass (seldom exceeding 1 to 16 in large telescopes), a focal diaphragm of 0·3 inch transmits a portion of the sun's image, the size and heat of which is nearly equivalent to that of the whole image of the sun in a refractor of 32 inches focal length, and of 2 inches aperture.* This may usually be employed without injury to the dark glasses, and the field is quite large enough for sweeping over the sun's disk in searching for spots or other phenomena. In careful scrutinies, the suitable aperture must be employed. In some very large spots, the nuclei alone may thus be examined, without any disturbance from the bright surface.

"By this mode of observation I have ascertained the existence of a stratum of comparatively faint luminosity, which, as far as I know, has not been previously noticed. For this I would propose the appellation of *the cloudy stratum.* Its appearance gives the impression of considerable depth below the second luminous stratum which forms the *shallow*, or *penumbra*, usually seen round the nucleus of a spot; and from all the examinations I have hitherto made, it seems to me probable that it is not self-luminous, but of such a nature as to absorb a vast quantity of light, and reflect very little. Its faint illumination is rarely uniform, presenting rather a mottled or cloudy surface; and occasionally some small patches are very decidedly more luminous than the rest, though still incomparably less bright than even the stratum forming the penumbra; from which it also differs essentially in being destitute of the striated or ridged appearance so frequently presented in that stratum.

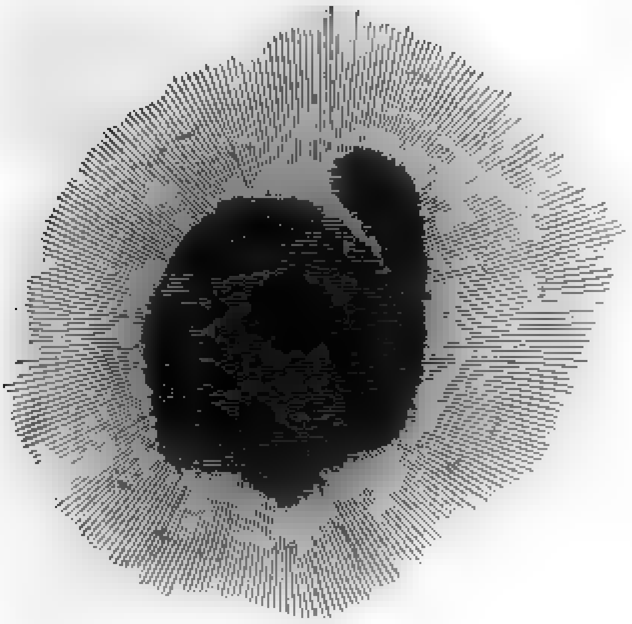
"In all spots of considerable size, and in many small ones, a *black opening* is perceivable in the cloudy stratum. In no instance have I perceived any light in these openings which exceeded the illumination of the earth's atmosphere by the sun's rays. It is obvious that any degree of light inferior to this cannot be rendered visible by any contrivance we can employ; just as the red projections from the sun's border cannot be seen except when the solar illumination of our atmosphere is nearly extinguished by the intervention of the moon. In order to obtain a measure of this illumi-

* In the observations of the solar eclipse of July last, Mr. Lassell found that his dark glasses would bear an aperture of 2 inches, with a focal length of 32·5 inches, after they had been carefully heated over a lamp. With an aperture of 2·55 inches, "the dark glasses broke with most alarming rapidity." At the same place, with a telescope of 42 inches focus and 2·75 aperture, Mr. Williams *had dark glasses* cracked which had been in frequent use for five years.

nation of the atmosphere, and to ascertain the limit which it sets to our researches, I have usually directed the telescope, with a very small field, to the sky close to the sun's edge, using the lightest shade of darkening glass which my eye could comfortably bear. Then, using the same shade, the telescope is directed with the smallest diaphragm to the dark part of a large spot. In this way the cloudy stratum will in general become visible, frequently occupying by far the greater part of what has been hitherto considered the *nucleus* of the spot, and imagined to be, in fact, the body of the sun itself. A portion of it, however, will commonly be found to appear perfectly black, whence we may conclude that, if luminous at all, it is less so than our own atmosphere when illuminated by the direct rays of the sun. To this black part only the appellation of *nucleus* appears to be strictly applicable." See the figure below marked January 17, which consists of the penumbra, the cloudy stratum, and the true nucleus.

A remarkable instance of *rotatory* motion was observed in a spot which was sketched on January 17 and January 23.

Jan. 17.



Jan. 23.

The rotation was not of the smaller round the larger portion. "*The whole spot had rotated round the small black nucleus.*"

On examining the surface of the sun carefully, using a very small field, Mr. Dawes is persuaded that "the apparent rapid fluctuation of the porous structure is not real, but the effect of disturbance in our own atmosphere."

Mr. Dawes states his conviction of the superiority of large apertures with high powers in viewing the sun, which this reduction of the field makes easy. The *faculæ*, too, are seen far better with large apertures, especially when the power is not proportionally high.

"These are best seen near the east and west edges of the sun's disk, where they give the impression of narrow ridges, whose sides are there presented to view. They usually lie nearly in the direc-

tion of a circle of latitude on the sun's surface, and are rarely high enough to be seen as actual projections from his limb. On one occasion, however, the 22d of January last, I had an opportunity of observing a satisfactory confirmation of the idea that they are ridges, or heapings up of the luminous matter; and as the requisite circumstances are extremely rare, I will advert more particularly to the observation. A large bright streak, or *facula*, was observed to run, as usual, nearly parallel to the sun's edge for some distance, and very near it; and then to turn rather abruptly towards the edge and pass over it. The limb was at times very well defined; and when it was most sharp and steady, the bright streak was seen to *project slightly beyond the smooth outline of the limb*, in the manner of a mountain ridge nearly parallel to the sun's equator."

This eye-piece was applied to Mr. Lassell's 20-foot reflector last September, and the sun was examined with the whole of the 24-inch mirror. The eye-piece did not become more than sensibly warm after two hours' exposure to a bright sun.

Mr. Dawes points out the utility of this contrivance in examining the surface of the moon, in observing the occultations of small stars, and the eclipses of *Jupiter's* satellites, and in observing or detecting the faint satellites of planets. By such means, too, *Venus* and *Mercury* may be more pleasantly observed when near the sun; and as the author remarks, "to the practised observer such applications will readily occur," and need not be here insisted on.

Mr. Dawes' eye-piece was constructed by Mr. Dollond according to Mr. Dawes' directions.

Micrometrical Measurements of the Binary Star ξ Ursæ Majoris, and the Double Star Struve 1263, made at the Observatory, Whitehaven. By J. F. Miller, F.R.S.

ξ Ursæ Majoris. Magnitudes, 4,5 ; 5,5. Colours, both white.

Reference.	Position.	Weight.	No. of Obs.	Distance.	Weight.	No. of Obs.	Epoch.
	° ′			″			
63	122 11	3	9	2·883	3	8	1852·066
66	122 35	3	8	2·859	3	8	·076
67	123 5	1	7				·112
68	122 27	3	8	2·886	2	6	·133
70	122 22	3	8	2·867	2	8	·136
75	121 41	3	8	2·912	3	8	·161
77				2·944	3	9	·169
80	122 16	4	8	2·935	2	5	·180
Means	122 17	20	56	2·898	18	52	1852·129

63. Jan. 24, 1852. Distances between clouds. This is only the third clear night we have had since Dec. 23, 1851.

67. Encke's comet seen at 7 P.M. Midnight; stars dance perpetually, and *definition bad*; no dependence can be placed upon this set of positions.

70. A most brilliant aurora, covering three-fourths of the sky; stars dim in consequence.

80. Moon one day past full, but at a low altitude: 11^h to 13^h. This being the last set which I intend to take this season, nearly two hours were devoted to the positions, and extraordinary care bestowed upon each individual measure. I therefore consider the mean of this series to represent the angle as exactly as my skill and means will permit.

ξ *Ursæ* is certainly one of the most interesting and remarkable of the binary systems, and it has, perhaps, been more fully and satisfactorily examined than any other. The following *resumé* of its history shows that it has performed an entire revolution and an eighteenth part of a second cycle since its angular position was first noticed by Sir William Herschel in the spring of 1780, seventy-two years ago. The angular velocity is now diminishing, a necessary consequence of the increase in distance between the companion sun and its primary.

	Position.	Distance.	Epoch.
	° ′	″	
Herschel I............	143 47	3·50	1780·33
Struve	276 35		1820·13
Herschel II. and South	258 27	2·81	1823·29
Struve	238 75	1·747	1826·20
—	213 59	1·671	1829·35
—	195 94	1·750	1832·41
—	184 10	1·875	1834·44
Dawes	171 37	1·920	1836·27
—	165 97		1837·36
Struve	160 38	2·260	1838·43
Smyth	156 9	2·000	1839·23
—	143 2	2·30	1843·16
Struve	140 52	2·526	1844·778
—	138 49	2·620	1846·365
—	131 50	2·700	1847·407
—	128 43	2·752	1848·406
Miller.................	122 17	2·898	1852·129
Fletcher..............	119 46	2·924	1852·197

Struve, 1263. Magnitudes, 9; 9,5. Colours, yellowish white.

Reference.	Position.	Weight.	No. of Obs.	Distance.	Weight.	No. of Obs.	Epoch.
	° ′			″			
72	14 46	2	8	20·105	1	10	1852·148
74	15 15	2	9	20·346	1	4	·150
76	15 48	4	8	20·941	4	8	·161
79	16 12	3	8	21·133	2	4	·169
84	16 8	2	3	20·786	3	8	·191
85	16 10	5	8	21·220	5	8	·194
Means	15 50	18	44	20·934	16	42	1852·169

84. Distances taken first; it became clouded before positions were completed.

85. The definition (which has long been very indifferent), is much improved,

and on the whole these are the best observations which I have obtained of this star. There are three other very small adjacent points, visible only in a dark field. This double star bears but a slight degree of illumination, and a pretty bright night is requisite to bisect the stars accurately in distance.

Subjoined are M. Struve's prior measures :—

	Position.	Distance.	Epoch.	Nights.
	° ′	″		
Struve	359 00	4·86	1828·36	1
—	4 12	5·43	1829·36	2
—	4 95	7·08	1831·31	2
—	7 27	7·455	1832·33	2
—	8 00	7·973	1833·29	3
—	8 40	8·933	1834·36	3
—	9 29	9·595	1835·35	4
—	9 60	10·325	1836·41	2
Miller	15 50	20·934	1852·17	6

On projecting the above measures, it becomes evident that the stars are not physically connected. The great and rapid increase in distance is doubtless the effect of very considerable proper motion in one of the components, and hence this object seems worthy of a rigid scrutiny with the large meridian instruments in different national observatories. This star presents another example that apparent magnitude or lustre is not always, if indeed generally, an indication of proximity to the solar system, and furnishes a hint that in searching for proper motion and sidereal parallax, the stars invisible to the naked eye should by no means be neglected.

March 19. We have now had an uninterrupted continuance of fine weather for more than a month, and a large proportion of clear bright evenings and nights ; yet there has not been a single night in all that period, wherein the air was in a really satisfactory state for astronomical purposes. The stars have been affected by a constant tremor, the definition has been very indifferent, and on many evenings (clear to the eye), so extremely bad, that, as far as micrometrical measurements are concerned, the sky might as well have been covered with clouds. The peculiar flickering or twinkling, which is usually confined to the brighter stars, has of late palsied the whole visible heavenly host almost without intermission. So long a continuance of wretched astronomical weather, with a clear sky, I never remember. The year 1852 has, so far, been most unpropitious to the labours of the astronomer. Rain fell almost without intermission till the 17th of February,* and from that time up to the present, during which the weather has been of the most opposite description (not a drop of rain having fallen), unfavourable atmospheric influences of a different character have proved almost equally fatal to the successful prosecution of delicate astronomical work.

March 29.† With the exception of Monday the 22d, when 0·105 inch of rain fell, the fine, dry, calm weather has continued uninterrupted since the last note was written. The atmosphere, when clear, militates as strongly as ever against the astronomer. Probably the perpetual dancing and moulding of the stars is owing, in a great measure, to the excessive dryness of the lower strata of the air.

During the last ten days, the dew-point has occasionally been as much as 17°, 18°, and even 20°·8, below the temperature of the air. With a single exception, we have now had forty-one days without rain, a circumstance probably without a parallel in the memory of the existing generation in this district.

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* During this period (Jan. 1st to Feb. 17th), 11·56 inches descended at Whitehaven, and 47·70 inches at Seathwaite in the Lake district.

† Some rain fell in the course of the night, 29th–30th.

Opposition of Mars, 1851–1852, *observed at the Cape of Good Hope.* By Mr. Maclear.

This memoir contains a numerous series of observations with the mural circle of *Mars*, and the stars in the *Ephemeris of the Stars proper to be observed with Mars near the opposition of the planet in* 1852.* The refraction is computed and applied, and there are 46 days between December 22, 1851, and February 28, 1852, on which observations have been made.

Mars in Opposition in 1852. By Mr. Warren De la Rue.†

"Since October 17, 1851, when I made the drawing of *Mars*, which at a former meeting I presented to the Society, I have repeatedly examined the planet with my thirteen-inch Newtonian, and on most occasions have been struck with the distinctness of the white spot surrounding the north pole; but I never saw the details on its surface so vividly defined as on January 4, xiv^h, and January 25, xii^h, when I made the drawings which I have now the honour of presenting to the Society, and which I believe to be as faithful delineations of the aspect of *Mars* at these epochs, as my pencil, unaided by micrometrical measurements, could produce.

"On reference to the drawings, it will be remarked that the northern white spot extended to about the same parallel of latitude at both periods (39° from the limb), and that its outline was indented and irregular; and it will be also perceived that the south polar regions, though paler in colour than the general ruddy tint of the planet, were not white.

"On the 4th of January there existed, a little to the east of the planet's centre, a dark stripe which, running north and south, divided the disc into two unequal halves; but before reaching the poles it spread eastward and westward, forming two broad irregular zones, the southern zone being the darker of the two, and the northern becoming paler as it approached the white spot.

"At the time of observation on the 25th, 20 days 22 hours had elapsed since that on the 4th, the planet had therefore completed twenty rotations and $\frac{140}{360}$ths, so that the central dark streak, visible on the 4th, by moving through 140° had become invisible; whilst the eastern limb of the 4th had nearly reached the western limb of the planet's disc visible on the 25th. Referring to the drawing for the latter date, there will be perceived in the south-west quadrant, three distinct irregular dark markings surrounded by whitish boundary-lines to which I would wish to direct particular attention, as many similar white streaks, as well as minute dark spots, were visible on the surface of the planet; but they flitted in and out of view with such tantalising rapidity, that it was impossible for me

* *Nautical Almanac*, 1852, p. 565 et *seq*.

† Along with this notice Mr. De la Rue presented two very beautiful drawings of *Mars*, which may be seen at the apartments.

to record them. In the north-west quadrant there existed a broad irregular marking running north and south, and spreading westward along the boundary of the northern white spots."

"The night of the 25th was even finer than that of the 4th, and the telescope and atmosphere being both in good condition the image of the planet was scarcely impaired by any false light, but presented during the hour occupied in making the sketch, a continuous impression of hard and distinct markings, which appeared to be inconsistent with the supposition that the configuration could be due to a clouded atmosphere."

On the Parallax of β Centuuri. By Mr. Maclear.

The observations on which this investigation is founded were made between July 29, 1842, and October 28, 1844, under the same circumstances, and nearly at the same time, with a portion of the observations of *α Centauri*, published in Vol. xx. of our *Memoirs*. The result is not to be deemed conclusive, but it has sufficient weight to make it of considerable positive value. A new series of observations has been commenced since, with the systematic circumspection demanded by such researches, but which was not previously practicable.

The mode of observation, computation, &c. is the same as that described in the *Memoirs*, vol. xx.

It does not appear that *β Centauri* has any *decided* proper motion. The mean N.P.D. for Jan. 1, 1843, is 149° 36′ 41″·6.

By 137 observations of *β Centauri*, Mr. Maclear finds,—

Parallax *β Centauri*	= 0″·47	Probable Error	0″·044
Constant of Aberration	= 20·59	— —	0·049

Errata in Mr. Maclear's Memoirs, Vol. XX. Roy. Ast. Soc. Mem.

Vol. xx. page 52, column B.A.C. *for* 4339, *read* 4399.
— — — 54, line 13 from top, R.A. of Rümker, *for* $14^h\ 36^m\ 34^s{\cdot}5$, *read* $14^h\ 36^m\ 44^s{\cdot}5$.
— — — 55, line 16 from top, *for* $15^h\ 0^m\ 5^s{\cdot}9$, *read* $15^h\ 0^m\ 5^s{\cdot}59$.
— — — 25, Oct. 21, *for* reduction 22″·84, *read* 23″·84.
— — — — — — *for* 127° 30′ 15″·60, *read* 127° 30′ 14″·60.

Extracts of a Letter from Lieut. Gilliss, U.S.N.

"*Santiago de Chile.*

"The weather continues to favour us in one sense, having enabled me to obtain above 800 differential measures between *Mars* and stars in the ephemeris sent you, besides meridian observations of the *N. A.* ephemeris also. . . . Brorsen's comet will be *looked* after as soon as it comes within striking distance of our

instruments: thanks to the copy of *Astr. Nach.* . . . . I have thought for the last eight or ten nights that η *Argûs* is diminishing in brightness. It certainly is not brighter than the combined light of α *Centauri*, as it was again last summer; but the two are not yet favourably situated for comparison, being at unequal heights. . . . Can you not persuade one of your munificent patrons of astronomy to send his powerful telescope out here? I am convinced that it would unfold more wonders in physical astronomy *every year* than a lifetime would afford in your atmosphere."

Extracts of a Letter from Lieut. Gilliss, U.S.N., to Capt. Smyth.

" 1852, *January* 20, *Santiago de Chile.*

" By the last mail from home, I received a copy of the 'Contributions to Astronomy and Geodesy,' forming part of vol. xx. *Mem. Ast. Society*, by Thos. Maclear, Esq. . . .

" You are probably aware it formed no part of my intention to re-examine existing catalogues, but to make a systematic sweep of the heavens from the pole towards the zenith, completing as much as possible in the time appointed for our stay in Chile. Each night's work is roughly compared with the catalogue to ascertain discrepancies of note, if any, and learn whether any star seen by others has been accidentally passed over. Subsequently becoming convinced that we must leave a belt of 25° between the zenith and pole unexamined, I devoted every Sunday night, when the assistants claimed holyday, to a search for those stars in Lacaille between the zenith and the upper zone, which had never been seen by any other observer. In this proceeding, a great many errors have been corrected, portions of which have been made known to astronomical friends from time to time, beginning with yourself, in July 1850, though whether any others have published them I have no means of knowing, Dr. Gould's journal having reached me very irregularly. Since the commencement of the series of observations on the planet *Mars*, my examination has, of necessity, been discontinued, and may not be resumed during the remainder of our stay here.

" I am glad to find that Mr. Maclear has confirmed the errors in the B.A.C. pointed out by our observations. There are one or two others in the same catalogue that are not mentioned by him, and I transcribe them from our note-book:—

No. 7619. There is no star in this position. Two, coinciding tolerably in declination, are in R.A. $21^h\ 43^m\ 0^s$ and $21^h\ 47^m{\cdot}0$ of the 10th and 9th mags. respectively.

7938. The proper motion in declination is not confirmed, and Lacaille is correct.

Errors in Lacaille's Catalogue.

No. 134. Polar distance, 10′ too great.

619. The nearest star so bright as 9th follows 30^s, and is 10′ north.

697. The nearest star to this position precedes it 35^s, and is 9′ south.

829. A double star follows this position 15^s and 8′ south, but there are no others.

No. 884. Not found when looked for, Nov. 9th, and Dec. 7th, 1851.
980. Does not exist here. I find 982.
1013. Right Ascension -10^s, Polar Distance $-4'$.
1094. The nearest star in this place follows 10^s and is $3'$ north.
1263. $2'$ too far south.
1283. } Two observations of these stars make their difference of R.A. $15^s.33$,
1285. } and of P.D. only $8''$.
1295. Nearly $8'$ too far south.
1334. Does not exist.
1339. I could not perceive any nebulous portion with all light off.
1414. Near $3'$ too far south.
1545. $2'$ too far south.
1816. } There is only one star, and this corresponds with the R.A. of the latter,
1819. } whilst its P.D. is between the two.
7678. Polar Distance $3'$ too great.
8746. Does not exist.
9070. The nearest star is $8\frac{1}{2}$ mag., 26^s west, and $3'$ north of this place.
9232. The star we find precedes $1^m\ 10^s$, and is $2\frac{1}{2}'$ south of this.
9247. Not found in two searches.
9645. Polar distance $3'$ too great.
9734. The nearest star is 33^s following, and $4'$ south of this position.

"Whenever a discrepancy is detected by our observations, the star is noted in a book kept for the purpose, and made the subject of special attention, being usually observed twice afterwards; and though the errors above given you are only approximate, those who are compiling for a new catalogue may very safely mark those named to *be disposed of hereafter*. This list has not been communicated to any other correspondent.

"I very greatly regret to be obliged to acknowledge two errors in the ephemeris of *Mars*, which was sent to you before I left the United States. The places of all the stars within certain limits, or rather the catalogues containing these places, were given to the young officers who were to accompany us, that they might compute the corrections necessary. Although the computations were in duplicate, you see the result: Dec. 25th, a star has been given for comparison, just $20'$ off, and Jan. 15th, another precisely 1° off. On the former night I repeated the differentials with the star of the preceding night; but on the latter was obliged to content myself with meridian observations only.

"Besides the star of the special ephemeris referred to, at least one of those in the *Nautical Almanac* is also observed. So far the work has given me much satisfaction. On some nights I have obtained as many as forty differentials, showing the motion of the planet in every interval with far greater precision than was expected; and if observers in the northern hemisphere have been alike successful, our mission may not have been in vain. So far, the only cloudy nights in December were the 15th, 17th, 18th, and 23d; in January, the 3d and 18th. In the former month there were 365 differentials, and in this above 400.

"A reduction of 27 moon-culminations and two occultations, on the assumption that the tabulated places are correct, makes our observatory $4^h\ 42^m\ 18^s.9$ West of Greenwich. There has recently *been a survey* between this city and Valparaiso, for the purpose of

locating a railroad; and the engineer, Allen Campbell, Esq., writes me, 'I am puzzled about longitude. I find that an air-line from Santa Lucia to Valparaiso does not exceed (by my survey) 64 English miles. Deducing the longitude of Valparaiso by this datum from your longitude, I make it only 71° 35′ 00″. Mr. Mowatt calls it 71° 40′ 30″, and by Capt. Fitzroy it is 71° 41′ 15″, making a difference between us of about 5 miles.' And, in a subsequent letter, he says, 'I have been over our work again, and we find it all right; so Valparaiso is undoubtedly farther east than Mowatt or Fitzroy make it. I am told old tables stated its longitude 71° 35′, and this would seem near the truth." A chronometer (pocket), which has been running very regularly, and brought here two days since, gives a difference of time $3^m\ 56^s{\cdot}1$, thus placing Valparaiso in $4^h\ 46^m\ 15^s$, if our longitude be correct. The same chronometer will be again transported in a few days, though too late for the result to be communicated in this letter. As the longitude of Valparaiso is of greater interest than that of any other point on the western coast, I have proposed to Señor Pissis, an engineer employed by the Chile Government to make a survey of the Republic, that we shall determine the difference of time between it and our observatory, by means of rockets and flashes of gunpowder. This will be carried into effect next month, there being a hill to the northward which is visible from both stations.

"Our geographical position has recently enabled me to observe two phenomena of more than ordinary interest, viz. two immersions and two emersions of η *Geminorum*, on the 5th inst., and an earthquake, under a magnifying power of 150, some nights afterwards; but my letter has already been extended beyond your patience perhaps, and I will not trouble you with them.

"The desire for information respecting the Wager has never been lost sight of; and the only person able to give any information has been talked with more than once. This is General Aldunate, formerly Intendent of Chiloe, but now Director of the Military Academy here. He seems to have no doubt that parts of the old ship would be found; but to do so, would require a special voyage, as the locality of the wreck is never visited. At the time of Capt. Fitzroy's survey, there was an old man on the island, who had assisted in removing a part of her guns, and with whom Fitzroy had a long conversation in the presence of the General.

"P.S. In my letter of July 28th, 1850, I find that an error of 2^m was made in giving you our longitude."

Extract of a Letter from Capt. W. S. Jacob of the Madras Observatory.

"I was quite unaware, until I saw it mentioned in the Annual Report for 1851, that the Lucknow Observatory was no longer kept up since the death of Col. Wilcox. It is my intention to act on the suggestion given in a note to the Report, that the Lucknow instruments might possibly be procured for Madras, and to apply

to the Government to that effect, as soon as I have ascertained from the Resident at Lucknow that the instruments are to be disposed of. I cannot, however, help thinking that Bombay would be a better place to transfer them to. There is there a better observatory than we have here, with no instrument except a 5-foot transit. The climate of Bombay is, astronomically, far superior to that of Madras, and I cannot but consider it very unfortunate that this place should have been pitched on as the site of the chief Indian Observatory, the climate being in my view very unsuitable; partly because from its relaxing nature few Europeans are able to keep up a prolonged series of observations without losing their health, and also because the amount of clear observing weather in the year is small compared with many other places in the country. Bombay is very superior in this latter respect; and I have no doubt it would be an advantage to science if that were made the principal observatory, and the astronomer located there instead of here, there being merely some one put in charge of the observatory here to give the time and rate chronometers, as is the case now in Bombay. An astronomer for each place would, of course, be better still, but of this there is little hope at present. Still better places than Bombay might be found, such as Poona, where the air is clearer and the climate less adverse to exertion; but to establish an entirely new station would involve a greater outlay in the way of buildings, &c., and would, therefore, be more difficult to accomplish. There is another point which I have to notice. In the same Report it is stated that application had been made to the East India Company, but without success, for the establishment of a large reflector on the Nilgherry Hills; this is a mistake. Will you, therefore, kindly correct this error by stating in the *Monthly Notices* that no direct official application has as yet been made to the East India Company on this subject? The Nilgherries would not, I fear, afford a good situation, as the proportion of cloudy weather there is nearly as large as here.

"My 2-foot speculum is, I regret to say, not in a very forward state. Our mutual friend, Capt. Worster, who had undertaken to make it, having, after two unsuccessful castings, been obliged by ill health and increased official duties, to lay it aside for a time: and within the last month he has gone to the Cape on sick leave for two years. He had succeeded with a third casting, and just commenced the rough grinding of it before he left. I am very doubtful of being able to complete it myself, my mechanical skill and experience in such matters being of very small amount. If completed, Poona would be the place to erect it at; there being no place of which I have any experience with so favourable a sky; it beats both the Cape and the Mediterranean entirely. But how that is to be done I do not see, for my private means are not sufficient to allow of my working it there on my own account, though, with a very little assistance, I would gladly do so, for here I feel myself to be of less use than I should like to be, and I do not think *my health will* enable me to hold out much longer."

On determining the Longitude at Sea from Altitudes of the Moon. By Lieut. E. D. Ashe, R.N.

"In the August of 1849 I was invalided at Valparaiso, with a fracture of the thigh-bone, and was ordered a passage to England in the Pandora, surveying-vessel. During my leisure, my attention was drawn to the subject of longitudes, by the circumstance of one of the chronometers (which had gone well for four years) changing its rate very considerably without any assignable cause; and knowing what implicit confidence is placed in a good chronometer, I felt that it was to be lamented that there was not some plan less laborious and of easier attainment than the lunar distance for checking chronometers; for, notwithstanding my experience of more than twenty years' sea time, I can only recollect one instance of the chronometers having been checked by the lunar distance, which may be, perhaps, accounted for by the many inconveniences attending the observation, and the large amount of practice necessary to ensure success."

The data for the problem proposed by Lieut. Ashe are, the sidereal time of the observation, the latitude of the place, and the observed altitude of the moon.

Lieut. Ashe first computes the zenith distance of the moon on the supposition that the observer is on the meridian of Greenwich. As the Greenwich sidereal time is known, the arc of the equinoctial between the moon's node and the meridian may be computed from the *Nautical Almanac*, and the angle which the moon's orbit makes with the equinoctial may be assumed to be equal to the moon's greatest declination. Hence the solution of a right-angled triangle will give the arc *on the moon's orbit*, from her node to the meridian, or arc a; the arc on the meridian between the orbit and the equinoctial, or arc b; and the angle included between these arcs, or γ.

Again, if a perpendicular be let fall from the zenith upon the moon's orbit, the angle in this triangle opposite the perpendicular will be γ, and the hypothenuse is the latitude of the place when increased or diminished by arc b; hence the value of the perpendicular arc, d is found, and also the distance of the foot of the perpendicular from the meridian, e: the addition or subtraction of e to a gives the longitude of the foot of the perpendicular, reckoned on the moon's orbit from the node.

Finally, having the values of the perpendicular on the orbit, and of the moon's zenith distance calculated for the meridian of Greenwich, the third side is computed, which, when applied to the last found arc gives the longitude of the moon on her orbit reckoned from the node,* on the hypothesis that the observer is on the meridian of Greenwich at the sidereal time supposed.

Lieut. Ashe then assumes that the change of meridian from

* This arc might perhaps be computed less indirectly from the right ascension and declination of the moon.

Greenwich to the place of observation will not alter the relation of these circles to each other, and that the moon will merely occupy another situation in her orbit. As the zenith distance at the place of observation is supposed to be known, there are, in the right-angled triangle requiring solution, the perpendicular on the moon's orbit, and the observed distance of the moon from the zenith; and from these data the longitude of the moon on her orbit, reckoned from the node, is found for the time and meridian of the place. The difference of the two arcs thus found, divided by the moon's motion, will give the difference in longitude between Greenwich and the place of observation.

Lieut. Ashe suggests a second mode of determining the longitude by an altitude of the moon, when compared with an altitude of the sun or a star.

"For the sake of simplicity, take an example with a star.

"Let the altitude of a star near the prime vertical be taken; and compute its hour-angle. As soon after as may be convenient, take the altitude of the moon, and find her hour-angle; the elapsed sidereal time, and run of the ship (if necessary), being applied to the hour-angle of the star, the hour-angles of moon and star are known at the instant of last observation, and consequently the right ascension of the moon is known from the right ascension of the star. A simple proportion will show what is the Greenwich time corresponding to this right ascension of the moon.'

"When the observations are made on the same side of the meridian, an error in latitude, or instrument, or that caused by bad horizon, or refraction, or personal equation, will not materially affect the 'difference' of the hour-angles, since the errors are common to both triangles Z P S and Z P M, and both are augmented or diminished nearly alike; and therefore the 'difference' between erroneous hour-angles will be nearly equal to the difference between correct hour-angles."

Note.—The practical objection to using altitudes of the moon at sea, for getting the longitude, is, that the horizon is seldom so well defined as to allow of great accuracy, and that, unless the moon's orbit makes a considerable angle with the horizon, her motion in her orbit may not be shown satisfactorily by motion in altitude. The lunar distance observation is capable of much greater accuracy; and by using stars on both sides of the moon, a large portion of the necessary errors of observation are diminished: the motion in her orbit is more favourably shown. The calculations are by no means laborious or complicated; but it must be admitted that great nicety is required to make the observations well, and that the instrument must be of the best kind. On land, perhaps, lunar altitudes would be available in lowish latitudes, as the angle is doubled by the mercurial horizon, and the observation is easy and of great exactness. If a seaman wished to use altitudes of the moon as a coarse check on his chronometer, the easiest method would be to calculate the sidereal time, using the moon as a star, upon two approximate suppositions of the longitude. If that were pretty nearly known, a simple interpolation would show the true longitude; *i. e.* that which gives the true sidereal time, supposed to be already ascertained. But we should guess, in the absence of actual trial, that a very bad lunar distance would give more trustworthy results than a very good lunar altitude.—*Editor.*

On the Graduation of Circles. By Mr. R. L. Jones.

The principle proposed by Mr. Jones may, perhaps, be understood from the following description: the details would require a drawing.

The circle to be divided must have a permanent or temporary vertical axis on which it turns horizontally. A frame to which a telescope is attached, which also carries a steel straight-edge for drawing the divisions and a powerful microscope for viewing them when drawn, turns on the upper part of the axis. This apparatus can be clamped to the circle, and the circle can be clamped to a horizontal bed.

On a wall at some distance from the circle two dots are inserted, so that the angle between the dots shall subtend 90° at the centre of the circle. It will be seen that, by a process of *stepping*, not unlike observing with a repeating table, the circle can be divided into four *equal* arcs, and from the over or underlapping at the end, the correction of one of the dots, to make the angle *exactly* 90°, can be readily computed. These tentative fine divisions might be cut very lightly on a portion of the limb outside the final graduation. This correction being made, the accurate division into four arcs of 90° might be effected at once.

A similar proceeding would divide the circle into any number of aliquot parts. By an intermediate dot the arcs of 90° might be subdivided to arcs of 45°. Everything remaining steady, the bisection of a division by the microscope and of a dot by the telescope should always bring back the apparatus into a given state.

Mr. Jones proposes to set out at the same distance two points which subtend an angle of 1°; its truth can be proved and the error corrected by stepping from one of the divisions into 45° to another division. It would be easy to subdivide this degree into any required number of parts, as at the distance of about 100 yards, 60 inches subtend an angle of 1°. When this space was once ascertained to be = 1°, there would be no need of further experiments, as the position of the circle bed and the prototype division need not suffer any disturbance.

Mr. Cooper, of Markree Castle, County Sligo, exhibited a MS. sheet of the star-map now constructing by his astronomer, Mr. A. Graham, from the joint observations of himself and Mr. Graham. The scale is four times that of the celebrated Berlin charts. In the *Monthly Notice* for December last, p. 32, a description will be found of the manner in which the observations (on which the star-maps are founded) were made; and the beauty of the manual execution of the maps by Mr. Graham, corresponds with the excellence of the determination of the places of the stars.

In the brief notice of Professor von Boguslawsky, in the last Annual Report, a serious oversight was committed by the translator. It is said that the magnetical instruments of the Breslau Observatory were furnished by the British Government, at the recommendation of Humboldt and of the British Association. This is not correct. The instruments were presented by the British Association, *without any assistance from the Government*, and on their own knowledge. Neither did the series of observations begin so early as is stated, for the instruments were not sent till 1839. We are obliged to Colonel Sabine for these corrections.

Ready for the Press,

Cometic Orbits, with copious Notes. By Edward J. Cooper, Esq.

The object of the compiler of this work was to produce a catalogue of those comets whose orbits have been computed, together with such notes on their physical appearances, as should save astronomers the trouble of reference to a great many volumes of works written in different languages, and, in fact, prove a useful manual.

The catalogue will contain 198 distinct comets and 786 orbits. The volume will be printed and bound uniformly with the *Markree Catalogue of Stars near the Ecliptic*, and its price will be 5*s*.

The Royal Society takes sixty copies.

The attention of astronomers is particularly called to the following work, *The History of Physical Astronomy from the Earliest Ages to the Middle of the Nineteenth Century*, by Robert Grant, F.R.A.S., in 1 vol. 8vo. pp. 638.

Mr. Bishop presented a copy of the tenth hour of his ecliptic charts which has recently been engraved. It is exceedingly clear and distinct, and perfectly adapted to its object, namely, to facilitate the search for new planets.

Mr. Nasmyth suggests that all telescopic observations should be invariably accompanied with a notice of the focal length, aperture, and magnifying power of the telescope employed. If a uniform system were adopted, very little space would be lost even by a frequent repetition. The focal length and aperture might be in inches and decimals of an inch, thus: 42, 3·75; 80, would describe a $3\frac{1}{2}$-foot telescope, aperture $3\frac{3}{4}$ inches, and power 80.

On Luminous Meteor-like Bodies, telescopically visible in Sunshine. By the Rev. W. R. Dawes.

The luminous bodies, which have been occasionally observed with a telescope in full sunshine, are so far astronomically interesting in consequence of their resemblance to meteors, as to render it desirable to ascertain their real nature; and with the hope of throwing light upon the subject, I beg to lay before the Astronomical Society a somewhat detailed account of some observations I made upon such bodies last autumn, under peculiarly favourable circumstances. Thinking that Mr. Read, who communicated his observations on some similar appearances in the autumn of 1850, might have had opportunities of repeating his examination of them in the course of last year, I postponed the communication of my observations, hoping that further light might have been thrown upon the subject by himself. As, however, he has, in the *Monthly Notice* for December last, only given a more full account of his observations of the previous year, I presume he has found no opportunity of repeating them.

On two or three occasions, during my residence at Cranbrook, I noticed similar appearances while observing in daylight, though never in such extraordinary numbers as Mr. Read saw them, nor as they were observed by myself last autumn. On previous occasions I had soon satisfied myself as to their real nature; yet, on the appearance of Mr. Read's account, I determined to take the first favourable opportunity of more carefully examining them, and noting down the particulars of the phenomenon. Such an opportunity occurred on the 9th of September, 1851.

The day was cloudless, the sun hot, the wind from about E.N.E., and dry. A little before noon, I was preparing to observe the sun with my $8\frac{1}{2}$-foot refractor; and while looking at it through the finder with a glass sufficiently dark to render the sun's light easy to the eye, I was surprised to see a bright object pass across pretty rapidly, nearly from east to west. In a few seconds another passed nearly in the same direction. Four or five more passed in quick succession, when Mr. Read's observation was brought to my recollection, and I determined to institute a careful examination of the phenomenon.

The brightness of the objects seemed very surprising, when it was considered that the sun was actually in the field of the finder, with a sufficiently dark glass applied, and yet they attracted my attention as they passed rapidly across.

Having applied a positive comet-eye-piece with a large flat field, and magnifying 65 times, I directed the telescope as near to the sun as my eye would bear without the defence of a dark glass, having previously adjusted the focus on the edge of the sun by the help of a dark glass, which was then removed. Immediately plenty of these luminous objects were seen, all passing nearly in the same direction, namely, from about E.N.E. to W.S.W.; but a few proceeded from N.E. or N.N.E. Some of them were much larger

than others; the largest being usually the roundest, and moving across the field in less time than the smaller ones, though, from their size and brilliance, it was easier to keep the eye upon them.

No obvious *phase* was visible in them, though they were not always of equal brightness in every part. Their brilliance greatly increased as the direction of the telescope approached the place of the sun; and though a dark glass of pretty deep tint then became needful to defend the eye, the objects were bright in the field, and they were the brightest when the sun itself was admitted a little way into the field, the dark glass being of sufficiently deep shade to permit the sun to be comfortably viewed through it. As a comparative standard of their brilliancy at a greater distance from the sun, I moved the telescope upon the planet *Venus*, which was then about 6° to the west of the sun. Plenty of the luminous objects passed through the field, and many of them were *much* brighter than the planet. On applying the dark glass with which I had seen them so well near the sun, *Venus* was totally hidden, as she was also with a far lighter shade of glass. The extraordinary increase of brilliancy which they acquire from being viewed nearly in the direction of the sun is thus made strikingly apparent. As the phenomenon was so well exhibited, I called out a member of my family to view it, who remarked that the objects looked very much like meteors. Some of them appeared larger than the planet *Jupiter* would do with the same power.

Having on former occasions ascertained that similar appearances were caused by *feathered seeds*, and especially those of thistles, floating with the breeze, and seen out of focus, I unclamped the circles of the equatoreal and moving the telescope freely with one hand, while the other was applied to the sliding adjusting-tube of the eye-piece, I was enabled to follow many of the most conspicuous of them, and to bring them correctly into focus. Their real nature thus became apparent. The largest were seen to roll over and over, and in some the feathery down was distinctly visible. The focal adjustment on the different objects varied greatly, showing that they were at very different distances; and in almost every instance the smallest were the most distant.

Between four and five o'clock in the afternoon, I varied my observation of them by bringing the sun into the south-west portion of the field, with a focal adjustment on the telescope considerably longer than was suitable for the sun. Many were still floating across, though I thought them less numerous than in the middle of the day. Several entered the north-east side of the field, and appeared extraordinarily bright till they passed on to the sun's disk, on which they immediately became dark spots, much like the third and fourth satellites of *Jupiter* when transiting his disk; but those which happened to be pretty correctly in focus were beautifully defined on the sun, and the feathered down of some of them more distinctly seen than in any other situation. From the differences observable among them, however, I think it probable that the seeds of several very different plants were floating together in the air,

besides those of various species of thistle (*Cnicus lanceolatus* and *Cnicus arvensis*), such as the seeds of dandelion, groundsel, and some kinds of willow (*Salix triandra* especially). It should be remarked that the weather had been for some time previously very dry and calm, and that on the day of observation a brisk air was stirring.

By screening my eyes from the direct rays of the sun, and looking steadily as near to the sun as the glare would permit, I could occasionally discern one or two sparkling points moving in the air; but in general they were much too high to be discerned without telescopic aid.

Though it is of course impossible to decide that these objects were of the same character as those observed by Mr. Read, yet the similarity of the phenomena seems to render it almost certain that they were so. In Mr. Read's communication the direction of the wind is not mentioned. That none of them should have been seen in the night renders their meteoric character highly improbable: had such a dense shoal of bodies so brilliant as those described either by Mr. Read, or in this paper, passed in the night, they would have sufficed to turn darkness into day. It is worthy of remark that Mr. Read's observations were made at almost precisely the same time of the year as my own; and I believe such an appearance will be seen only in the summer or autumn.

Letter from Lieut. R. Wilcox, R.N., Worthing, on a remarkable Appearance at Sunset.

"On the evening of April 8th, about 5 minutes after sunset, a red column arose from the place of the sun, and gradually ascended until it had attained a height of about 25° above the horizon; it there remained for 23 minutes and suddenly disappeared. The column had not a ray-like appearance as in the northern lights, but was of equal breadth from the base to the summit, and had the appearance of a bright red flame. I do not know if this appearance is very uncommon, but I have never happened to observe it before during a long service at sea."

Extract of a Letter from Mr. Spencer Hall to Capt. W. H. Smyth, R.N.

"As you think a few lines on the column of light seen at sunset on the 6th and 8th of April, may be of use in comparing statements, I am induced to trouble you upon the matter. I should state I was at Brighton for the recovery of my health, and that it was my constant habit to walk on the West Parade from 5·30 to 6·30 or 7 every evening. I was also in the habit of watching the sunset, for the purpose of comparing the real with the pictorial effects given by great artists, merely as a means of self-instruction.

faster than seemed to agree with the rate at which the sun itself was sinking, and as if the column was undergoing a reduction in length.

"The light, at first, was of a faint yellow, with a tinge of pink. Afterwards the yellow hue gave place to the pink, the latter becoming rather deeper in colour; but this colour all through was faint, and partook of the general tint of the sky, or rather of the smoke and vapour of the neighbourhood.

"I have mentioned that the smoke of Leeds was interposed between myself and the sun. The light of the column was sufficiently strong to appear as if it cut through and divided the smoke; in other words, as if there was no smoke whatever in the space occupied by the column.

"A neighbour, Sir George Goodman, who lives about four miles north-west of Leeds, and on higher ground, observed this column of light with an addition of three cross-bars at the top. But of these no trace whatever was perceptible from my grounds."

Mr. Patrick Diggins, of Dunmore East, County Waterford, intimates that he has discovered "a new method of finding the latitude when the object is off the meridian;" the requisite data are "the apparent time from noon, and the latitude by account." No description of the computation is given.

Capt. Shea has furnished a continuation of his drawings of the solar spots. He remarks a particular arrangement on the 17th, 18th, and 19th of February, which he considers to have a strong resemblance to a ship.

Erratum in No. V.

Page 152, line 4 from the bottom, *for* 18″·61, *read* 28″·61.

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ROYAL ASTRONOMICAL SOCIETY.

VOL. XII. *May* 14, 1852. No. 7.

J. C. ADAMS, Esq., President, in the chair.

Rev. John Richardson, Elizabeth College, Guernsey, was duly elected a Fellow of the Society.

June 11, 1852. No. 8.*

G. B. AIRY, Esq., Vice-President, in the Chair.

Lieut. William Burdon, R.N., was duly elected a Fellow of the Society.

The Queen's warrant has been issued, granting a pension of 200*l*. to our Foreign Secretary, Mr. John Russell Hind, "for important astronomical discoveries." We understand that the Earl of Rosse, P.R.S., brought Mr. Hind's merits before the consideration of Government, and, which enhances the obligation, without Mr. Hind's knowledge.

The *Berliner Jahrbuch* for 1855 has just been received. It contains Ephemerides for 1853 of the following newly-discovered small planets:—*Hebe*, *Iris*, *Flora*, *Metis*, *Victoria*, *Egeria*, *Eunomia*, and *Melpomene*. There are no Ephemerides of *Astræa*, *Hygeia*, *Parthenope*, *Irene*, *Psyche*, *Thetis*, *Fortuna*, or *Massilia*. An Ephemeris of *Neptune* by Dr. Brünnow, on the Elements and Perturbations of Professor Peirce, is given; the Elements are considered a little more exact than those inserted in the *Jahrbuch* for 1854.

* The publication of the *Monthly Notices* has fallen into some disorder, from various causes, and principally on account of the absence of the Editor. It has been thought most advisable to publish the *Notices* for May and June together, and to include everything which has been received up to the date of publication. The greater frequency and regularity of the appearances of the *Astronomische Nachrichten* renders it a far better channel of communication for Ephemerides than the *Monthly Notices* can ever pretend to be.

Vol. XXXIV. of the *Astronomische Nachrichten* closed with No. 816. It is requested that the subscribers who have not yet paid for Vol. XXXV. will forward their subscriptions, 11*s.* 6*d.*, to Mr. Williams. The payments are in *advance*, and the Numbers are sent by *post.*

At last the Editor is able to say that the price fixed for the volumes of the *Astronomische Nachrichten*, up to the death of the lamented Professor Schumacher, is 6*s.* per volume. When six volumes are taken, the price will be 5*s.* There is no copy of Vols. I. and III. and only one of Vol. II., three of Vol. IV., and two of Vol. VII. Of the other volumes there is a tolerable supply, and a considerable quantity of single Numbers, which would be supplied at 4*d.* the Number. The Editor earnestly requests that gentlemen who wish to purchase either Volumes or Numbers will give him early information, as the cost of transmission to this country, which must be added to the above prices, will be comparatively very large if the parcels are small. The payments may be made to our Assistant-Secretary, Mr. Williams, who has very kindly offered his assistance.

MASSILIA.

On the 19th of September, Professor de Gasparis, of the Observatory of Naples, discovered a new planet, which was about the 9 mag. On comparing the planets with Lalande 203; Lalande 449 = Weisse 273; Lalande 579 = Weisse 330; it was judged to be a little less bright than the first of those stars.

NAPLES. (Dr. A. de Gasparis.)

1852.	Naples M. T. h m s	R.A. h m s	Decl. ° ′ ″
Sept. 19	10 20 24	0 12 10·73	+1 53 0·6
20	7 50 22	11 22·62	47 16·8
21	8 55 54	10 25·72	40 47·1
22	14 17 40	9 18·38	33 10·2
23	16 7 30	8 19·08	26 18·6
24	11 52 21	7 34·78	20 52·0
25	12 20 41	6 37·72	14 59·0
27	9 16 40	4 55·34	1 3 20·6
28	9 44 47	3 59·84	0 56 35·2
29	8 29 0	3 7·00	50 47·0
30	8 55 22	2 11·62	44 15·7
Oct. 1	11 31 58	0 1 11·20	+0 37 18·6

This planet was also discovered at Marseille by M. Chacornac, who, on November 20th, remarked a small star of the 9th magnitude in a place where before he had seen no star. Between $10^h 50^m$ and $15^h 30^m$ its R.A. diminished 10^s. On further examina-

tion M. Chacornac found that a star which he had noted on Sept. 9 was now missing.

1852.	Marseille M.T. h m	R.A. ° ′		Decl. ° ′	
Sept. 9	12 0		5 4		+2 40
20	12 2	* Lalande 449	m s −4 54	* Lalande 449	′ ″ − 9 45
	15 57		−5 4		−10 45
21	10 40	44 Piscium	−7 28	44 Piscium	+33 15

The name proposed by M. Chacornac was *Massilia*, before the previous discovery by Dr. de Gasparis was known at Marseille, and in this name the first discoverer has, we understand, acquiesced.

HAMBURG. (M. C. Rümker.)

1852.	Hamburg M.T. h m s	R.A. ° ′ ″	L. Fact. Par^x.	Decl. ° ′ ″	L. Fact. Par^x.	Comps.
Sept. 30	14 9 32·0	0 29 44·5	+9·5992	+0 42 57·0	9·9015	6
Oct. 2	8 5 24·4	0 6 3·3	−9·6894	0 32 5·9	9·9028	7
3	10 12 2·0	359 51 39·7	9·1631	0 25 19·5	9·9021	3
6	8 38 0·0	359 13 25·4	9·5246	+0 13 10·6	9·9033	1
8	8 27 49·3	358 48 16·5	9·5265	−0 3 59·1	9·9046	9
9	8 0 32·8	358 36 11·8	9·5832	0 9 42·3	9·9051	7
12	8 6 25·8	358 0 42·6	9·5224	0 26 12·9	9·9063	8
13	7 52 29·2	357 49 34·2	9·5551	0 31 29·6	9·9066	7
16	7 43 58·6	357 17 40·3	−9·5436	−0 46 37·9	9·9079	10

Apparent Places of Stars of Comparison.

1852.	R.A. h m s	Decl. ° ′ ″	1852.	R.A. h m s	Decl. ° ′ ″
Sept. 30	0 10 14·04	+0 52 11·8	Oct. 8	0 1 19·89	−0 7 36·1
	7 4·36	28 42·3	9	0 1 19·90	−0 7 36·2
	6 15·58	33 56·8	12	23 53 6·62	−0 35 49·0
Oct. 2	0 0 6·85	+0 31 45·2		53 55·86	31 3·0
	1 55·25	25 27·1		54 26·82	41 17·6
3	0 1 55·27	+0 25 27·1	13	23 53 6·62	−0 35 49·1
6	23 52 28·12	+0 16 10·6		53 55·86	31 3·1
	53 1·91	14 46·7	16	23 47 14·51	−0 42 34·3

ALTONA. Mer. Circle. Dr. Petersen.

1852.	Altona M.T. h m s	R.A. h m s	Decl. ° ′ ″
Oct. 3	11 8 20	23 59 24·10	+0 25 4·2

SOUTH VILLA. (Mr. Hind.)

1852.	Green. M.T. h m s	R.A. h m s	N.P.D. ° ′ ″
Oct. 2	11 21 3	0 0 15·64	89 28 54·9

FORTUNA.

Discovered by Mr. J. R. Hind, at the South Villa Observatory.

"On August 22d, at $11^h\ 30^m$ mean time, I detected another planet, equal in brightness to a star of the 9th magnitude, near the northern limit of our ecliptical chart for 22^h of R.A. It was micrometrically compared with Weisse xxii. 493, and the motion westward was appreciable in about twenty minutes. The star has been meridionally observed at Greenwich.

"Mr. Bishop having deputed me to name this (our sixth) planet, I have proposed to call it *Fortuna*. The following observations have been carefully reduced, and will I believe prove pretty exact:"—

1852.	Green. M.T. h m s	App. R.A. h m s	App. N.P.D. ° ′ ″
Aug. 22	11 35 39·4	22 22 29·75	97 32 18·9
	12 27 16·3	27·89	30·0
26	9 17 31·2	22 19 3·92	97 53 33·1
Sept. 8	11 29 15·2	22 7 49·58	99 6 35·7
	11 38 31·6	49·30	37·0

Liverpool. Equatoreal. (Mr. Hartnup.)

1852.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	Star of Comparison.
Aug. 26	13 55 2·8	22 18 53·48	+8·254	97 54 44·2	−9·9370	B.A.C. 7784
	14 18 58·6	52·24	·335	51·3	·9349	— —
	14 42 54·3	51·19	·398	57·2	·9292	— —
30	12 7 5·3	22 15 24·82	+7·475	98 16 50·4	−9·9428	— 7773
	12 32 0·2	23·72	·865	56·8	·9422	— —
Sept. 1	10 4 47·9	22 13 44·09	−8·214	98 27 39·1	−9·9399	— —
	10 19 45·1	43·56	·144	42·4	·9409	— —
2	10 5 59·5	22 12 51·90	−8·188	98 33 16·1	−9·9408	— —
	10 20 57·0	51·49	7·111	20·9	·9417	— —
3	10 48 3·7	22 11 58·82	−7·876	98 39 2·7	−9·9436	— —
	11 3 1·1	58·28	·691	6·0	·9441	— —
13	12 17 1·4	22 4 3·59	+8·203	99 32 28·0	−9·9440	— 7670
	12 39 27·6	2·69	·292	35·1	·9418	— 7773
16	12 32 40·3	22 2 3·49	+8·315	99 46 46·4	−9·9418	— —
	12 47 37·8	3·22	·360	49·7	·9401	— —

Assumed *Mean* Places of the Stars for 1852·0.

	R.A. h m s	N.P.D. ° ′ ″	Authority.
B.A.C. 7784	22 12 24·49	98 33 43·7	Greenwich 12-years Catalogue.
— 7773	22 9 1·21	98 31 5·0	Greenwich Observations.
— 7670	21 55 29·22	97 14 7·7	Greenwich 12-years Catalogue.

HAMBURG. (M. C. Rümker.)

1852.	Hamburg M.T. h m s	R.A. ° ′ ″	L. Fact. Parˣ.	Decl. ° ′ ″	L. Fact. Parˣ.	Comps.
Sept. 2	9 22 31·1	333 13 51·7	−9·4851	−8 32 54·8	9·9396	13
	11 23 56·3	12 37·2		33 23·7	9·9464	Mer.
3	9 27 42·8	332 60 47·2	−9·4515	8 38 34·4	9·9409	18
	11 19 9·0	59 45·8		38 59·0	9·9467	—
5	8 58 3·0	332 35 39·2	−9·5179	8 49 40·3	9·9395	11
	11 9 36·6	34 32·4		50 6·5	9·9475	—
6	9 36 5·7	332 22 53·8	−9·3585	8 55 10·9	9·9437	6
	11 4 41·2	22 6·9		55 30·6	9·9479	—
7	8 38 50·3	332 11 4·0	−9·5444	9 0 23·3	9·9389	7
	11 0 6·6	9 55·5		1 0·9	9·9482	—
8	9 2 55·8	331 58 53·9	−9·4558	9 6 1·9	9·9423	10
	10 55 23·1	57 59·0		6 21·9	9·9485	—
9	9 0 21·0	331 47 16·3	−9·4494	9 11 1·7	9·9427	6
	10 50 40·3	46 14·9		11 35·8	9·9489	—
11	9 2 16·7	331 24 12·8	−9·4135	9 21 37·0	9·9443	5
	10 41 18·6	23 40·5		21 58·5	9·9496	—
13	10 19 16·2	331 2 7·4	−8·5272	9 31 47·8	9·9495	2
	10 31 59·7	1 52·5		31 58·3	9·9502	—
14	8 42 25·1	330 51 54·9	−9·4285	9 36 40·0	9·9448	1
	10 27 22·9	51 39·0		36 50·3	9·9505	—
16	8 29 34·4	330 32 54·5	−9·4427	9 45 50·5	9·9450	4
	10 18 12·9	32 1·9		46 13·6	9·9511	—
17	8 51 50·3	330 23 32·9	−9·4786	9 50 31·8	9·9442	4
	10 13 40·3	22 49·6		50 48·6	9·9514	—
21	9 55 44·6	329 49 42·4		10 7 35·1	9·9525	—
22	11 49 20·3	329 41 57·2	+9·4800	10 11 43·1	9·9452	4
25	9 38 15·2	......		10 21 50·4	9·9534	—
Oct. 2	9 8 50·3	328 54 43·7		10 41 24·5	9·9545	—
3	11 5 13·8	328 52 24·1	+9·4848	10 43 46·5	9·9468	5
8	8 44 51·1	328 48 46·5		10 51 24·9	9·9551	—
9	8 40 50·2	328 49 30·9		10 52 29·8	9·9552	—
12	8 29 30·4	328 54 29·3		10 54 48·0	9·9554	—
16	8 14 41·6	329 8 15·4		−10 54 55·9	9·9557	—

Mean Places for 1852·0, of Stars compared with *Fortuna*, deduced from observations with the Hamburg Meridian Circle.

R.A. h m s	Obs.	Decl. ° ′ ″	Obs.	R.A. h m s	Obs.	Decl. ° ′ ″	Obs.
21 51 6·13	3	−10 52 59·4	3	22 7 9·53	3	−9 42 25·0	3
21 53 57·14	2	10 35 8·2	2	22 7 45·19	1	9 7 51·1	1
21 59 53·53	1	10 47 53·9	1	22 9 3·48	2	9 46 32·1	2
22 2 30·56	2	10 6 49·1	2	22 11 20·99	1	8 32 13·1	1
22 3 16·99	1	8 43		22 13 2·46	1	9 30 24·2	1
23 3 24·08	1	8 43		22 14 28·75	1	−8 13 40·2	1
22 4 46·71	2	−8 44 28·2	2				

Elements.

By Mr. E. Vogel, of Mr. Bishop's Observatory, South Villa, Regent's Park.

	° ′ ″		
M	321 13 12·08	1852, Sept. 10·0 Greenwich M.T.	
π	30 23 29·12	Mean Equinox,	
☊	211 35 25·26	Jan. 0.0, 1852	
i	1 32 13·13		
φ	9 3 55·67		
Log e	9·1974538		
Log a	0·3875506		
Log μ	2·9686807	$\mu = 930''·423642$	

These elements, which are deduced from the observations at South Villa, August 22; at Greenwich, Aug. 30; and at South Villa, Sept. 8, exactly represent the middle observation.*

MELPOMENE.

Discovered by Mr. J. R. Hind, at the South Villa Observatory.

"On June 24th, at 12^h 30^m mean time, I remarked an object resembling a star of the 9th magnitude in a part of the heavens in 18^h R.A., which, from previous acquaintance with the vicinity, I was satisfied must be a new planet, the other members of the group between *Mars* and *Jupiter* all occupying different positions. Observations with the wire-micrometer indicated a sensible change of R.A. in 15^m. The Astronomer Royal having been requested by Mr. Bishop to name the newly discovered planet, has called it *Melpomene.* I remarked on the first night, and on several subsequent occasions, a strong yellowish colour about the light of this object, quite different from the appearance of the telescopic stars in the same field of view."

"The following are the positions of *Melpomene*, resulting from observations with the wire-micrometer. The comparison-stars up to July 3 have been observed by Mr. Airy, who has kindly favoured me with the resulting mean places which have been used in my reductions:"—

1852.	Green. M.T.	App. R.A.	App. N.P.D.
	h m s	° ′ ″	° ′ ″
June 24	12 50 19·7	18 12 59·92	98 15 52·0
	13 17 45·4	58·80	54·7
	14 3 28·0	56·67	58·2
26	10 16 29·0	18 11 0·94	98 20 57·6
29	10 11 45·5	18 7 52·23	98 30 0·1

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* Mr. Vogel sent at the same time an approximate Ephemeris from Sept. 14 to Oct. 14, which is omitted here, as being out of date. The Editor fears that the blame of delay on this occasion rests with him, but the Ephemerides not contained in the *Nautical Almanac* are to be found in the *Astronomische Nachrichten.*

1852.	Green. M.T. h m s	App. R.A. ° ′ ″	App. N.P.D. ° ′ ″
June 30	10 16 23·4	18 6 49·05	98 33 33·2
July 2	11 3 31·6	18 4 42·43	98 40 51·9
3	11 46 11·6	18 3 38·89	98 44 53·9
9	11 4 47·2	17 57 42·50	99 11 41·1
	11 7 43·7	42·38	45·8
30	9 10 59·8	17 42 45·66	101 21 0·4

Liverpool. Equatoreal. (Mr. Hartnup.)

1852.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	Star of Comparison.	
Aug. 25	9 14 19·4	17 43 25·41	+8·224	104 34 21·5	−9·9594	B.A.C.	5976
	9 39 16·4	25·70	8·317	31·5	9·9558	—	—
31	8 34 5·9	17 46 46·15	8·128	105 17 51·8	9·9637	—	—
	8 58 3·2	46·55	8·242	55·3	9·9608	—	—
Sept. 1	8 50 47·6	17 47 26·75	8·226	105 25 6·0	9·9616	—	—
	9 14 45·0	27·08	8·316	12·6	9·9580	—	—
2	8 9 37·8	17 48 7·30	8·015	105 31 53·9	9·9660	—	—
	8 33 35·1	7·70	8·161	62·9	9·9641	—	—
16	7 50 15·4	18 0 53·81	8·159	107 4 33·4	9·9677	—	6086
	8 5 14·1	54·78	+8·229	36·4	−9·9657	—	—

Assumed *Mean* Places of the Stars for 1852·0.

		R.A. h m s	N.P.D. ° ′ ″	Authority.
B.A.C.	5976	17 33 5·92	102 47 28·1	Greenwich Observations.
—	6086	17 52 47·22	107 8 46·2	Greenwich 12-yr. Catalogue.

Haverhill. (W. Boreham).

1852.	Green. M.T. h m s	R A. h m s	Log P	N.P.D. ° ′ ″	Log *p*	No. of Obs.	
June 29	10 18 14	18 7 50·58	−8·6185	98 30 11·9	−0·8722	9	*a*
30	10 36 36	6 48·72	8·5677	33 32·3	0·8722	9	*a*
July 3	10 58 33	3 40·75	8·3954	44 58·1	0·8775	9	*b*
4	10 36 28·4	2 40·21	8·7175	48 58·2	0·8733	10	*b*
5	10 22 46·5	1 39·79	8·7747	53 12·2	0·8737	10	*b*
6	10 20 57·8	18 0 40·20	8·7848	98 57 28·7	0·8736	10	*c*
7	10 46 7	17 59 39·55	8·1607	99 2 1·5	0·8736	7	*d*
8	10 22 52	58 41·73	−8·7119	6 38·5	0·8716	10	*d*
9	10 55 44·4	57 42·61	+8·1903	11 39·5	0·8753	10	*d*
11	10 10 14·3	55 51·58	−8·6311	21 42·2	0·8757	5	*d*
12	10 41 34·5	54 56·08	+8·3533	27 0·5	0·8765	10	*e*
21	10 32 57	47 43·25	+8·8387	100 20 21·8	0·8782	10	*f*
22	10 44 52	17 47 2·03	+8·9868	100 26 52·5	−0·8784	10	*g*

$\frac{P}{\Delta}$ and $\frac{p}{\Delta}$ = parallax in R.A. and N.P.D. respectively in seconds of time and arc, Δ being the distance of the planet from the earth. The observations are already corrected for refraction.

Assumed *Mean* Places of the Stars compared with the Planet.

		R.A.	N.P.D.
		h m s	° ′ ″
a	Weisse, XVIII, 147	18 7 27·42	98 31 44·5
b	— — 61	18 3 56·15	98 45 39·1
c	— — 7	18 1 36·57	98 47 30·5
d	— XVII, 1212	17 57 37·31	99 16 8·1
e	B.A.C. 6078	17 50 52·88	99 45 2·3
f	Weisse, XVII, 980	17 48 16·69	100 9 38·2
g	— — 906	17 45 0·85	100 19 52·4

HAMBURG. (M. C. Rümker.)

1852.	Hamburg M.T.	R.A.	Par^x.	Decl.	Par^x.	Comp^s.	
	h m s	° ′ ″	″	° ′ ″	″		
June 28	12 7 31·8	272 12 50·7	+0·5	−8 27 5·3	+4·9	10	
30	10 16 50·5	271 42 43·4	−1·3	33 24·1	4·9	3	
July 2	12 42 27·7	271 10 1·8	+1·5	41 1·9	4·9	15	
3	12 0 24·3	270 54 58·0	+0·8	44 52·4	4·9	19	
4	10 26 39·1	270 40 40·4	−1·0	48 44·1	4·9	9	
	11 10 21·9	25 3·2		50·9	6·1		Mer. Circle
5	10 20 16·3	270 25 27·1	−1·0	52 53·5	4·9	14	
	11 5 25·8	25 3·2		5·8	6·1		Mer. Circle
6	11 0 30·0	270 10 2·0	...	8 57 26·8	6·1		— —
7	10 55 34·9	269 55 12·2	...	9 2 1·0	6·1		— —
8	10 50 40·8	269 40 36·4	...	6 41·7	6·1		— —
9	10 45 47·1	269 26 8·8	...	11 29·8	6·0		— —
10	10 40 55·0	269 12 3·5	...	......	...		— —
11	10 36 3·5	268 58 6·8	...	21 36·7	6·0		— —
12	10 31 13·7	268 44 27·7	...	26 53·1	6·0		— —
14	10 21 37·6	268 18 4·0	...	37 50·3	6·0		— —
15	10 16 49·0	268 5 14·3	...	43 28·1	6·0		— —
16	10 12 3·7	267 52 52·5	...	49 15·4	6·0		— —
17	10 7 19·4	267 40 43·4	...	9 55 9·6	6·0		— —
20	9 53 16·8	267 6 54·0	...	10 13 36·1	6·0		— —
22	9 44 2·7	266 46 17·9	...	26 16·9	6·0		— —
23	9 39 27·9	266 36 35·4	...	32 49·9	5·9		— —
24	9 34 55·4	266 27 21·5	...	39 23·8	5·9		— —
25	10 40 53·0	266 18 9·2	+1·2	46 32·8	4·6	14	
26	9 25 54·9	266 10 9·4		10 52 57·0	5·9		Mer. Circle
	10 20 15·5	9 56·0	1·2	10 53 12·0	4·5	13	— —
28	9 17 2·4	265 54 56·4		11 6 50·0	5·9		Mer. Circle
29	9 12 38·8	265 48 1·5		13 41·4	5·9		— —
30	9 18 17·2	265 41 33·8		20 55·9	5·8		— —
	10 18 29·9	41 27·8	+1·2	21 4·5	4·5	6	
Aug. 1	8 59 39·8	265 30 8·3		−11 35 8·3	+5·8		Mer. Circle

1852.	Hamburg M.T.	R.A.	Par^x.	Decl.	Par^x Comp^s.	
	h m s	° ′ ″	″	° ′ ″	″	
Aug. 2	10 26 42·6	265 25 0·6	+1·5	−11 42 44·2	+4·4	4
4	9 28 39·9	265 16 30·4	0·7	11 57 0·1	4·3	10
7	9 11 42·4	265 7 32·4	0·6	12 19 5·4	4·0	4
16	9 9 21·0	265 8 36·1	1·1	13 26 52·0	5·3	
17	8 56 15·4	265 11 20·5	0·9	13 34 12·5	5·3	
Sept. 3	8 27 0·6	267 12 43·4	1·3	15 38 45·7	4·9	
4	8 23 35·8	267 23 58·9	1·3	45 37·7	4·9	
5	8 15 9·7	267 35 43·6	1·2	52 39·1	4·9	
6	8 25 9·4	267 48 1·1	1·3	15 59 35·6	4·8	
7	8 4 0·3	268 0 30·6	1·2	16 6 14·3	4·8	
8	8 16 36·9	268 13 46·2	1·3	13 6·9	4·8	
9	8 29 40·5	268 27 22·7	1·5	19 44·5	4·7	
14	8 5 21·0	269 36 40·6	+1·4	−16 53 8·5	+4·7	

The parallax is not applied to the observations.

Mean **Places for Jan. 0, 1852, of Stars which are near the geocentric path of *Melpomene*, by M. C. Rümker, from Meridian Observations.**

Mag.	R.A.	Obs.	Decl.	Obs.	Mag.	R.A.	Obs.	Decl.	Obs.
	h m s		° ′ ″			h m s		° ′ ″	
9	17 30 14·67	2	−12 16 26·6	2	9	17 49 45·21	1	−9 18 8·9	1
9	33 41·05	1	13 51 36·8	1	9	52 12·48	3	9 29 51·0	3
9	36 0·45	1	12 8 15·1	1	9	54 8·92	1	10 29 56·0	1
8.9	36 8·41	2	12 58 29·0	2	8	55 46·87	2	9 15 4·2	1
9	37 25·07	4	11 30 42·8	4	8	56 17·00	1	9 15 46·4	1
8	37 39·83	2	10 17 17·2	2	9	57 2·76	1	9 34 49·2	1
8	37 59·51	2	13 14 35·4	2	8	57 37·31	4	9 16 3·1	3
8	38 0·31	1	13 14 24·0	1	8	17 59 26·76	5	9 11 25·2	5
8	40 28·15	2	10 12 54·8	2	8	18 1 36·18	3	8 47 30·4	3
9	40 50·35	3	11 17 4·0	1	7	3 56·23	2	8 45 31·4	2
8.9	41 14·70	2	10 42 53·7	2	9	5 37·23	1	9 54 24·1	1
8.9	41 34·70	2	10 25 17·0	2	10	6 13·84	1	8 43 50·5	1
9	42 5·91	2	12 6 40·9	1	9	6 19·71	1	8 11 42·5	1
8.9	43 51·56	2	9 56 3·6	2	8.9	7 26·91	7	8 31 42·0	7
7	44 50·10	2	10 51 29·6	2	8	10 3·35	2	8 41 4·8	2
8	45 1·10	1	10 19 43·0	1	9	12 3·64	1	8 36 24·3	1
7	45 52·94	4	11 18 4·7	2	9.10	13 22·72	7	8 20 45·8	7
7	48 16·47	1	10 19 42·2	1	6	18 25·16	1	8 15 57·8	1
9	17 48 20·11	1	−9 35 9·3	1	9	18 19 2·99	1	−8 57 39·4	1

Elements and ephemerides of *Melpomene* will be found in Nos. 818, 819, 820 of the *Ast. Nach.*

There is some error in the R.A. of the second observation of July 4.

Assumed *Mean* Places of the Stars compared with the Planet.

		R.A.	N.P.D.
	h	h m s	° ′ ″
a	Weisse, XVIII, 147	18 7 27·42	98 31 44·5
b	— — 61	18 3 56·15	98 45 39·1
c	— — 7	18 1 36·57	98 47 30·5
d	— XVII, 1212	17 57 37·31	99 16 8·1
e	B.A.C. 6078	17 50 52·88	99 45 2·3
f	Weisse, XVII, 980	17 48 16·69	100 9 38·2
g	— — 906	17 45 0·85	100 19 52·4

HAMBURG. (M. C. Rümker.)

1852.	Hamburg M.T.	R.A.	Parx.	Decl.	Parx.	Compe.	
	h m s	° ′ ″	″	° ′ ″	″		
June 28	12 7 31·8	272 12 50·7	+0·5	−8 27 5·3	+4·9	10	
30	10 16 50·5	271 42 43·4	−1·3	33 24·1	4·9	3	
July 2	12 42 27·7	271 10 1·8	+1·5	41 1·9	4·9	15	
3	12 0 24·3	270 54 58·0	+0·8	44 52·4	4·9	19	
4	10 26 39·1	270 40 40·4	−1·0	48 44·1	4·9	9	
	11 10 21·9	25 3·2		50·9	6·1		Mer. Circle
5	10 20 16·3	270 25 27·1	−1·0	52 53·5	4·9	14	
	11 5 25·8	25 3·2		5·8	6·1		Mer. Circle
6	11 0 30·0	270 10 2·0	...	8 57 26·8	6·1		— —
7	10 55 34·9	269 55 12·2	...	9 2 1·0	6·1		— —
8	10 50 40·8	269 40 36·4	...	6 41·7	6·1		— —
9	10 45 47·1	269 26 8·8	...	11 29·8	6·0		— —
10	10 40 55·0	269 12 3·5	...	......	...		— —
11	10 36 3·5	268 58 6·8	...	21 36·7	6·0		— —
12	10 31 13·7	268 44 27·7	...	26 53·1	6·0		— —
14	10 21 37·6	268 18 4·0	...	37 50·3	6·0		— —
15	10 16 49·0	268 5 14·3	...	43 28·1	6·0		— —
16	10 12 3·7	267 52 52·5	...	49 15·4	6·0		— —
17	10 7 19·4	267 40 43·4	...	9 55 9·6	6·0		— —
20	9 53 16·8	267 6 54·0	...	10 13 36·1	6·0		— —
22	9 44 2·7	266 46 17·9	...	26 16·9	6·0		— —
23	9 39 27·9	266 36 35·4	...	32 49·9	5·9		— —
24	9 34 55·4	266 27 21·5	...	39 23·8	5·9		— —
25	10 40 53·0	266 18 9·2	+1·2	46 32·8	4·6	14	
26	9 25 54·9	266 10 9·4		10 52 57·0	5·9		Mer. Circle
	10 20 15·5	9 56·0	1·2	10 53 12·0	4·5	13	— —
28	9 17 2·4	265 54 56·4		11 6 50·0	5·9		Mer. Circle
29	9 12 38·8	265 48 1·5		13 41·4	5·9		— —
30	9 18 17·2	265 41 33·8		20 55·9	5·8		— —
	10 18 29·9	41 27·8	+1·2	21 4·5	4·5	6	
Aug. 1	8 59 39·8	265 30 8·3		−11 35 8·3	+5·8		Mer. Circle

1852.	Hamburg M.T.	R.A.	Parx.	Decl.	Parx	Comps.
	h m s	° ′ ″	″	° ′ ″	″	
Aug. 2	10 26 42·6	265 25 0·6	+1·5	−11 42 44·2	+4·4	4
4	9 28 39·9	265 16 30·4	0·7	11 57 0·1	4·3	10
7	9 11 42·4	265 7 32·4	0·6	12 19 5·4	4·0	4
16	9 9 21·0	265 8 36·1	1·1	13 26 52·0	5·3	
17	8 56 15·4	265 11 20·5	0·9	13 34 12·5	5·3	
Sept. 3	8 27 0·6	267 12 43·4	1·3	15 38 45·7	4·9	
4	8 23 35·8	267 23 58·9	1·3	45 37·7	4·9	
5	8 15 9·7	267 35 43·6	1·2	52 39·1	4·9	
6	8 25 9·4	267 48 1·1	1·3	15 59 35·6	4·8	
7	8 4 0·3	268 0 30·6	1·2	16 6 14·3	4·8	
8	8 16 36·9	268 13 46·2	1·3	13 6·9	4·8	
9	8 29 40·5	268 27 22·7	1·5	19 44·5	4·7	
14	8 5 21·0	269 36 40·6	+1·4	−16 53 8·5	+4·7	

The parallax is not applied to the observations.

Mean Places for Jan. 0, 1852, of Stars which are near the geocentric path of *Melpomene*, by M. C. Rümker, from Meridian Observations.

Mag.	R.A.	Obs.	Decl.	Obs.	Mag.	R.A.	Obs.	Decl.	Obs.
	h m s		° ′ ″			h m s		° ′ ″	
9	17 30 14·67	2	−12 16 26·6	2	9	17 49 45·21	1	−9 18 8·9	1
9	33 41·05	1	13 51 36·8	1	9	52 12·48	3	9 29 51·0	3
9	36 0·45	1	12 8 15·1	1	9	54 8·92	1	10 29 56·0	1
8.9	36 8·41	2	12 58 29·0	2	8	55 46·87	2	9 15 4·2	1
9	37 25·07	4	11 30 42·8	4	8	56 17·00	1	9 15 46·4	1
8	37 39·83	2	10 17 17·2	2	9	57 2·76	1	9 34 49·2	1
8	37 59·51	2	13 14 35·4	2	8	57 37·31	4	9 16 3·1	3
8	38 0·31	1	13 14 24·0	1	8	17 59 26·76	5	9 11 25·2	5
8	40 28·15	2	10 12 54·8	2	8	18 1 36·18	3	8 47 30·4	3
9	40 50·35	3	11 17 4·0	1	7	3 56·23	2	8 45 31·4	2
8.9	41 14·70	2	10 42 53·7	2	9	5 37·23	1	9 54 24·1	1
8.9	41 34·70	2	10 25 17·0	2	10	6 13·84	1	8 43 50·5	1
9	42 5·91	2	12 6 40·9	1	9	6 19·71	1	8 11 42·5	1
8.9	43 51·56	2	9 56 3·6	2	8.9	7 26·91	7	8 31 42·0	7
7	44 50·10	2	10 51 29·6	2	8	10 3·35	2	8 41 4·8	2
8	45 1·10	1	10 19 43·0	1	9	12 3·64	1	8 36 24·3	1
7	45 52·94	4	11 18 4·7	2	9.10	13 22·72	7	8 20 45·8	7
7	48 16·47	1	10 19 42·2	1	6	18 25·16	1	8 15 57·8	1
9	17 48 20·11	1	−9 35 9·3	1	9	18 19 2·99	1	−8 57 39·4	1

Elements and ephemerides of *Melpomene* will be found in Nos. 818, 819, 820 of the *Ast. Nach.*

There is some error in the R.A. of the second observation of July 4.

IRENE.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

	Green. M.T.	R.A.	Log $\frac{p}{P}$	N.P.D.	Log $\frac{q}{P}$	Star of Comparison.
1852.	h m s	h m s		° ′ ″		
Sept. 3	12 47 57·1	23 17 10·45	+7·343	109 1 28·7	−9·9778	B.A.C. 8062
	13 25 52·1	9·72	·960	35·9	·9757	— —
8	11 30 6·0	23 12 51·43	−7·886	109 29 40·9	−9·9774	— —
	11 54 2·0	50·63	·520	44·4	·9787	— —
9	11 17 19·4	23 11 59·30	−7·961	109 34 54·1	−9·9769	— —
	11 45 14·7	58·36	·608	60·7	·9787	— 8161

Assumed *Mean* Places of the Stars for 1852·0.

	R.A.	N.P.D.	Authority.
	h m s	° ′ ″	
B.A.C. 8062	23 1 32·99	111 58 27·2	B.A.C.
— 8161	23 18 16·10	111 27 6·8	—

HYGEIA.

Professor Chevallier has computed an ephemeris of *Hygeia* for its present opposition from the elements given in the *Berlin Jahrbuch* for 1854. This ephemeris has been printed by the Professor and distributed. There are some copies at the Royal Astronomical Society, which will be forwarded on application.

EUNOMIA.

HAMBURG. (M. C. Rümker.)

	Hamburg M.T.	R.A.	Par^x.	Decl.	Par^x.	Obs.
1852.	h m s	° ′ ″	″	° ′ ″		
July 16	13 29 33·2	47 37 20·2	−2·4	+28 30 47·5	+2·5	2
17	12 15 47·5	48 6 6·2	2·2	28 39 29·6	2·8	7
23	12 42 14·4	51 3 26·1	2·5	29 35 43·3	2·7	8
24	11 56 1·4	51 31 50·4	−2·3	29 44 9·0	+2·9	11
			Log Fact. Par^x.		Log Fact. Par^x.	
Oct. 9	9 50 18·7	79 54 29·7	−9·8722	36 54 40·9	+9·8225	6
12	9 25 55·1	80 17 54·8	9·8703	37 12 26·3	9·8362	6
16	9 5 11·8	80 41 18·5	−9·8695	+37 11 36·1	+9·8418	6

Apparent Places of the Stars of Comparison.

	R.A.	Decl.		R.A.	Decl.
	h m s	° ′ ″		h m s	° ′ ″
Oct. 9	5 20 10·0	+37 12 24·2	Oct. 16	5 20 10·3	+37 12 24·6
12	5 22 24·1	+37 12 50·2		5 22 24·3	+37 12 50·5

Elements. By M. George Rümker.

Epoch, August 21.0, 1851.

M .... =	314° 4′ 38″·39	Jan. 0.0, 1852, Berlin M.T.
π	28 11 58·00	Mean Equinox, Jan. 0.0, 1852.
☊	293 54 48·29	
i	11 43 56·47	
φ	10 47 29·24	

Log a = 0·4214854 ; μ = 827″·52.

These elements were computed from the following observations.

Berlin M.T.	App. R.A.	App. Decl.	Observations.
1851.	° ′ ″	° ′ ″	
Aug. 21.0	271 54 37·48	−24 25 32·18	8 Camb 1 Berlin
Oct. 20.0	282 43 53·77	20 45 55·20	1 Camb. 3 Berlin 2 Hamb. 5 Wash.
1852. Jan. 9.0	316 17 9·35	−11 49 2·48	4 Wash.

The elements represent the middle observation thus :—

Calculated—Observed = + 0″·11 in long. ; −0″·06 in lat.

From the above elements, M. George Rümker computed an ephemeris* from July 1 to Nov. 7, taking into account the perturbations caused by *Jupiter*, according to the elegant and convenient formulæ given by Dr. Brünnow, *Ast. Nach.* 808.

THETIS.

MARKREE. Large Equatoreal and Square Micrometer. E. J. Cooper, Esq., and Mr. Graham.

Green. M.T.	R.A.		Decl.			
1852.	h m s		° ′ ″			
May 24·482979	11 58 18·27	+ [9·4045] : Δ	+ 8 8 10·1	+ [0·8047] : Δ	a	5
·482979	18·36	9·4045	10·4	0·8047	a	5
·501960	58 18·91	9·4452	8 5·9	0·8092	b	5
·501960	18·93	9·4452	5·5	0·8092	b	5
25·468457	11 58 41·96	9·3729	+ 8 3 19·8	0·8024	c	5
·468457	42·13	9·3729	20·6	0·8024	c	5
·490160	58 42·61	9·4263	3 13·8	0·8073	c	5
·490160	42·51	+ [9·4263] : Δ	14·4	+ [0·8073] : Δ	c	5

Coefficients for parallax logarithmic. Δ = distance from the earth.

Adopted *Mean* Places for 1852·0, of Compared Stars, with reductions to apparent places at the times of observation, and authorities.

	h m s	s	° ′ ″	″	
Weisse, 973	11 56 43·86	+ 0·63	+ 8 13 30·83	− 1·65	a
— 971	56 43·00	0·63	13 58·13	− 1·65	b
— 968	11 56 33·65	+ 0·62	+ 8 0 38·49	− 1·65	c

* This ephemeris is omitted, as being out of date at the time of publishing this Number; it will be found with other ephemerides in the *Ast. Nach.* There is an ephemeris up to Dec. 31 in No. 832.

For the observations of *Thetis*, a new eye-piece of higher power was used, which gives a larger and much flatter field, the bars of the micrometer being broader than were those in the old eye-piece. By taking the time from a half seconds sidereal chronometer, the observations were left to depend alone upon my own eye and ear.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1852.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	Star of Comp.
May 6	9 48 1·4	11 55 39·41	+7·845	80 54 51·0	−9·8429	B.A.C. 3982
	10 47 53·3	39·03	+8·232	55·8	−9·8474	— —

Assumed *Mean* Place of the Star for 1852·0.

	R.A. h m s	N.P.D. ° ′ ″	Authority.
B.A.C. 3982	11 38 15·14	82 38 29·7	Greenwich Observations.

PSYCHE.

MARKREE. Large Equatoreal and Square Micrometer. E. J. Cooper, Esq., and Mr. Graham.

Green. M.T. 1852.	R.A. h m s		Decl. ° ′ ″			
April 12·474149	9 50 8·62	+[9·3211] : Δ	+13 47 19·9	+[0·7609] : Δ	*a*	10
·506741	8·88	9·4167	24·2	0·7734	*a*	10
13·404241	50 7·58	8·8475	47 42·9	0·7439	a_1	10
17·398385	50 15·90	8·9081	49 3·2	0·7443	a_2	14
24·377393	9 51 16·99	9·0940	13 46 36·6	0·7483	a_3	5
·386856	16·77	9·1557	39·1	0·7505	a_3	2
May 22·464501	10 4 40·84	9·5043	+12 47 10·4	0·8018	*b*	5
·475595	40·79	+[9·5152] : Δ	8·9	+[0·8068] : Δ	*b*	5

Coefficients for parallax logarithmic. Δ = distance from the earth.

Adopted *Mean* Places for 1852·0, of Compared Stars, with reductions to apparent places at the times of observation, and authorities.

	h m s	s	° ′ ″	″	
Markree Mer. Cir. 5 obs.	9 49 11·09	+0·43	+13 51 32·80	−2·95	*a*
		0·42		2·88	a_1
		0·37		2·61	a_2
		0·28		2·18	a_3
Weisse, 45	10 3 40·09	+0·00	+12 45 51·88	−0·71	*b*

M. Rümker's determination of *a* is,

A.S.N. XII, 161 $9^h 49^m 10^s{\cdot}87$ $+13° 51′ 33″$.

April 13. Blowing hard. I fear the observation is worth nothing.
April 24. Occasional gusts of wind may have affected the observation.
May 14. Carefully observed what unfortunately was not the planet.

WESTPHAL'S COMET. II. 1852.

On the 24th of July, Dr. Westphal, of the Observatory of Göttingen, discovered a small comet about 1°¼ south of *f Piscium*. In the comet-seeker the comet seemed to be above 1′ in extent, and it was pretty bright. The position was estimated as follows:—

1852.	Göttingen M.T. h m s	R.A. h m	Decl. ° ′
July 24	12 0 0	1 11·7	+1 4

On the following night the comet was compared by M. Klinkerfues with Weisse i, 197; Dr. Westphal also estimated its position.

1852.	Göttingen M.T. h m s	R.A. h m s	Decl. ° ′	
July 25	13 55 20	1 12 59·4	+1 44	Comparison
	13 45 0	1 13·1	+1 47	Estimation

ALTONA. (Dr. Petersen and M. Sonntag.)

1852.	Altona M.T. h m s	R.A. h m s	Decl. ° ′ ″
July 27	14 10 30	1 15 29·12	+3 4 11·7
28	13 38 42	16 37·39	3 44 28·6
Aug. 10	12 55 50·1	31 30·17	14 27 5·4
12	13 18 32·4	1 33 45·58	+16 28 23·4

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1852.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	Star of Comparison.
Aug. 25	12 35 21·3	1 48 8·81	−8·535	57 44 25·5	−9·6605	B.A.C. 656
	13 5 18·0	10·13	8·474	42 37·6	9·6322	— -
Sept. 1	10 56 52·6	1 56 2·76	8·695	47 28 38·2	9·6313	— 676
	11 16 48·3	3·57	8·677	27 17·4	9·5977	— -
2	11 10 5·9	1 57 14·50	8·692	45 54 9·6	9·5822	— 706
	11 35 3·5	15·80	8·664	52 31·8	9·5350	— -
9	12 33 11·6	2 6 9·15	8·625	34 37 24·7	8·7902	— 721
	12 49 9·8	9·85	8·582	36 23·6	8·6201	— -
	13 5 8·4	10·49	8·532	35 17·7	8·3781	— -
17	7 54 50·9	2 18 44·78	−9·010	22 23 27·3	−9·6225	— 802

Assumed *Mean* Places of the Stars for 1852·0.

	R.A. h m s	N.P.D. ° ′ ″	Authority.
B.A.C. 656	2 0 45·00	55 42 54·8	Greenwich Observations.
— 676	2 3 57·74	46 27 56·9	B.A.C.
— 706	2 9 45·33	43 18 21·8	Greenwich Observations.
— 721	2 12 4·43	34 50 5·9	Greenwich 12-yr. Catalogue.
— 802	2 29 43·91	22 34 30·2	Oxford Observations.

HAMBURG. (M. C. Rümker.)

1852.	Hamburg M.T. h m s	R.A. ° ′ ″	L. Fact. Parx.	Decl. ° ′ ″	L. Fact. Parx.	Comps.
July 27	13 38 26·0	18 51 50·9		+3 3 33·5		
Aug. 10	11 6 31·6	22 51 8·0		14 22 45·0		
12	11 21 53·9	23 25 2·4		16 23 36·1		
Sept. 2	10 20 25·5	29 17 8·2	−9·8968	43 59 50·8	+9·6527	6
3	10 33 39·7	29 35 31·2	9·8981	45 35 26·5	9·6040	6
5	10 21 50·0	30 12 1·5	9·9287	48 45 21·0	9·5713	12
6	10 17 14·8	30 30 47·6	9·9360	50 21 54·3	9·5239	6
7	10 16 53·6	30 49 58·0	9·9578	51 57 30·3	9·5182	8
8	10 18 16·8	31 9 34·1	9·9709	53 34 5·2	9·4772	11
9	9 45 39·1	31 29 10·0	0·0059	55 8 35·8	9·5315	4
14	11 20 28·7	33 22 38·3	0·0008	63 11 26·6	8·0575	3
16	10 33 21·8	34 14 42·5	0·1075	66 13 25·1	8·6972	6
17	10 3 17·0	34 42 15·8	0·1606	67 42 12·6	8·9449	5
22	8 37 3·9	37 46 57·0	0·3571	74 48 43·1	9·2480	6
23	8 47 2·9	38 38 27·0	0·3955	76 10 45·4	+9·1194	1
25	9 26 46·4	40 46 28·5	0·4723	78 50 6·0	−7·5028	5
Oct. 3	12 37 45·5	82 54 28·0	−1·1003	87 37 40·6	−9·4140	1
16	11 52 48·7	203 36 21·5	+7·3512	80 11 46·1	+9·8601	4

Apparent Places of the Stars of Comparison.

1852.	R.A. h m s	Decl. ° ′ ″	1852.	R.A. h m s	Decl. ° ′ ″
Sept. 2	1 57 56·72	+44 3 16·9	Sept. 9	2 10 29·67	+55 13 27·5
3	2 1 51·83	45 30 43·7		10 39·02	8 27·8
	2 3·84	31 56·4		12 7·33	9 51·7
5	2 2 16·67	48 45 7·9	14	2 9 25·14	63 11 19·1
	2 22·49	53 52·7	16	2 11 8·95	66 9 45·0
	3 31·65	41 7·4		14 39·44	65 52 24·5
6	2 1 1·28	50 21 8·9	17	2 23 14·25	67 42 48·5
	3 49·76	22 31·2	22	2 31 17·81	74 46 28·1
7	2 5 39·46	51 49 4·0	23	2 42 0·40	76 28 25·5
	6 30·66	51 52 3·6	25	2 46 47·53	78 49 30·4
	6 46·13	52 1 49·1	Oct 3	6 29 49·48	87 14 56·2
8	2 3 16·26	+53 51 15·5	16	13 36 34·03	+80 6 10·2

Elements. By M. George Rümker.

T	1852, Oct. 9·51695, Berlin M.T.	
	° ′ ″	
π	40 21 57	App. Equinox, July 29
☊	346 44 22	
i	41 2 50	
Log q	0·111004	Motion direct.

These elements are computed from Hamburg observations of July 27 and the Berlin observations of July 29 and August 7.*

Computed—Observed = $+29''$ in Long.; $-2''$ in Latitude.

The elements have some likeness to those of the comet of 1793.

COMET OF CHACORNAC. I. 1852.

By Mr. G. P. Bond, Cambridge, U.S.

Mr. Bond *discovered* this comet on the morning of May 19th, and remarks that it was a faint insignificant object.

1852.	Camb. M.T. h m s	R.A. 1852·0. h m s	Decl. 1852·0. ° ′ ″
May 18	13 5 45	22 28 55·51	+74 35 53·2
19	9 36 9	26 12·47	76 53 15·2
20	9 37 18	21 38·85	79 31 47·8
21	11 14 37	22 13 30·74	+82 17 12·7

BIELA'S COMET.

On August 25, Professer Secchi discovered a small comet in the constellation *Gemini;* at $15\frac{1}{2}^h$ M.T. the comet preceded a small star of 9.10 mag. about 4^s, and at $15^h\ 52^m$ it exactly covered the star.

By comparisons with Lalande 14637, Professor Secchi found the following approximate place of the small star, viz.

R.A. ✱ = Lalande $14637 + 5^m\ 43^s{\cdot}6$, Decl. ✱ = Lalande $14637 + 5'\ 20''$
$= 7^h\ 29^m\ 31^s{\cdot}4$ $= +21°\ 48'\ 37''$ approximated.

The comet was subsequently compared with the star: the results are,

1852.	Rome M.T. h m	R.A.	Decl.
August 25	15 52	✱	✱
	16 14·5	✱ $+3^s{\cdot}85$	✱ $-42''$

This comet was suspected by Professor Secchi to be one of the parts of Biela's Comet, although the place differed considerably from that assigned by Professor Santini.

On Sept. 15 Professor Secchi discovered the other portion of Biela's Comet. It was very faint, without nucleus, and of a long oval shape, the point being turned to the sun. It followed the former portion in about 2^m, and was about half a degree to the

* An approximate ephemeris computed from the above elements between August 12 and September 21 was forwarded at the same time by M. George Rümker. This and another ephemeris by M. Sonntag are published in the *Astronomische Nachrichten.* It is now supposed to have a period somewhat less than 70 years.

south of it. The faintness of this latter portion, and the fear of missing the observations of the former portion, did not allow the Professor to make a more satisfactory estimate of the relative positions.

The larger and brighter portion had not the same shape as when seen on August 25: it was altogether irregular and with two very feeble brushes. The centre was more luminous than the edges, but there was no nucleus. The comet was compared with a star of the 10th mag. which was again compared with ζ *Leonis.*

R.A. $\ast$ = R.A. ζ Leonis $-7^{m}\ 7^{s}{\cdot}2$, Decl. $\ast$ = Decl. ζ Leonis $-16''$.

The observation of the comet is as follows:—

1852.	Rome M.T. h m s	R.A. s	Decl. ″
Sept. 15	16 13 58·4	$\ast$ −19·2	$\ast$ −53·2

On Sept. 19 the two portions of the comet were compared with Lalande 19134.

1852.	Rome M.T. h m s		R.A. m s	Decl. ′ ″
Sept. 19	16 3 54·36	Preceding Comet	$\ast$ −1 34·9	$\ast$ +10 2·3
	16 12 29·16	Following Comet	$\ast$ +0 17·42	$\ast$ − 4 8·2

The preceding portion being the fainter.

On Sept. 21 the comets were compared with a star of the 7th mag. which is found in Harding's charts, R.A. $9^{h}\ 38^{m}$, Decl. $+9^{\circ}\ 26''$, and is underlined.

	Rome Sid. T. h m s		R.A. s	Decl. s
Sept. 20	4 12 31·1	Preceding Comet	$\ast$ −25·03	$\ast$ +44·76 × 15 . cos δ
	4 26 0·2	Following Comet	$\ast$ +87·52	$\ast$ −12·12 × 15 . cos δ

A portion of the comet was observed by Professor Encke.

1852.	Berlin M.T. h m s	R.A. ° ′ ″	Decl. ° ′ ″
Sept. 17	15 45 16·7	141 32 4·9	+10 50 55·8

ENCKE'S COMET.

MARKREE. Large Equatoreal and Square Micrometer. E. J. Cooper, Esq., and Mr. Graham.

Green. M.T. 1852.	R.A. h m s	Decl. ° ′ ″	Comp^d Stars.	No. of Obs.
Jan. 17·304752	23 11 17·87	+4 31 24·4	*a*	
·304752	16·95	25·8	*b*	10
·304752	17·79	27·9	*c*	
20·296745	23 15 11·82	4 50 14·4	*d*	10
23·294799	23 19 19·54	5 10 25·6	*e*	
·294799	19·39	30·1	*f*	10
·294799	19·20	27·8	*g*	
·294799	19·28	24·1	*h*	

Green. M.T. 1852.	R.A. h m s	Decl. ° ′ ″	Comp^d Stars.	No. of Obs.
Jan. 24·294310	23 20 45·30	5 17 39·8	g_1	10
·300704	45·79	41·1	g_1	10
Feb. 13·314821	23 54 7·22	8 0 37·5	*k*	10
21·319601	0 9 26·45	9 0 35·1	*l*	8
24·307928	0 15 7·10	9 15 25·5	*m*	10
·328856	9·31	29·9	*m*	10
25·307405	0 16 57·75	9 18 32·1	*n*	10
·323949	59·24	43·9	*n*	10
Mar. 2·322882	0 26 22·89	+9 6 27·5	*o*	9

Corrected for parallax from Stratford's ephemeris.

Adopted *Mean* Places for 1852·0, of Compared Stars, with reductions to apparent places at the times of observation, and authorities.

	R.A. h m s	s	Decl. ° ′ ″	″	
B.A.C. 8127	23 12 48·19	−1·60	+4 34 26·46	−6·99	*a*
Weisse, 229	11 17·70	1·61	36 8·74	7·00	*b*
— 252	12 38·19	1·60	30 31·37	7·05	*c*
Rümker, A.S.N. XII, 138	14 31·19	1·62	4 41 38·90	7·29	*d*
Weisse, 340	16 50·30	1·63	5 22 25·80	7·40	*e*
— 359	17 50·11	1·62	13 41·04	7·44	*f*
— 413	20 44·02	1·61	15 38·80	7·46	*g*
— 414	20 44·68	1·61	17 5·40	7·46	*h*
— 413	20 44·02	1·60	5 15 38·80	7·37	g_1
B.A.C. 8353	23 54 49·50	1·61	8 7 58·80	8·70	*k*
Weisse, 126	0 7 47·66	1·61	8 55 42·93	9·09	*l*
— 280	16 19·99	1·60	9 6 5·59	9·24	*m*
— 317	19 15·68	1·60	9 19 46·94	9·25	*n*
— 436	0 25 49·61	−1·61	+8 57 11·96	−9·62	*o*

Mean Places for 1852·0, of Compared Stars, from other sources.

	R.A. h m s	Decl. ° ′ ″	
Piazzi, 49	23 12 47·82	+4 34 30·26	*a*
Rümker, A.S.N. XII, 138	12 48·22	34 28·38	*a*
Piazzi, 43	11 16·20	36 12·96	*b*
Lal. 45638	11 16·57	36 14·26	*b*
— 45683	12 37·98	30 22·72	*c*
— 45753	14 31·05	4 41 43·14	*d*
— 45818	16 49·85	5 22 30·36	*e*
— 45848	17 49·86	13 46·30	*f*
— 45952	20 43·67	15 43·88	*g*
Rümker, A.S.N. XII, 138	20 44·14	5 15 40·49	*g*
— — — 139	23 54 49·72	8 7 57·82	*k*
Lal. 563	0 19 15·21	+9 19 48·65	*n*

Jan. 17. Fancied a slight condensation, not central, but toward the N.E. The comet was excessively faint, and very difficult to observe. The want of a distinct nucleus necessarily makes the place uncertain.

Jan. 20. The comet appears like a very faint, wispy clond, rather more con densed toward the northern portion. I apprehend there may have been small stars seen through the body during the observation, which was most difficult and uncertain.

Jan. 23. The observation as satisfactory as could be expected from the extreme faintness of the object. I have never had a stronger impression of the very vapoury nature of such bodies.

Jan. 24. The comet was close north, following Weisse 414, so close that it increased the difficulty of the observation. The moon, also, rather troublesome. I cannot depend much on the observation though carefully taken.

Feb. 13. The alteration in the brightness of the comet is unexpectedly great. It is now a fine object. The light at least equal to that of a star 10th magnitude, and beautifully white. The appearance is that of a rich round nebula, with a concentration of light, but no nucleus. The faint nebulosity did not seem to extend so far in the N.E. direction as elsewhere.

Feb. 21. Beautifully shown. Like a fine round nebula, uniformly surrounded by an atmosphere gradually fading off.

Feb. 24. Beautifully shown. Observation made with great care.

Feb. 25. Observation very carefully made.

March 8. Observed an object near to where the comet ought to be; but its light was so bright and concentrated that I had much doubt whether it was not a star. If it was the comet, the compared star is Weisse, 476, which was extremely faint, and the places would be,—

	h m s	s	° ′ ″	″
Weisse, 476	0 27 51·44	−1·61	+7 19 53·22	−10·10
Comet, March 8·336181	0 29 4·35		+7 10 41·1	

I could not see Weisse, 510. The object was very low. Clouded before the observation could be satisfactorily completed.

March 10. Sought for the comet in a tolerably clear sky. Could not see it.

On the Comet of 1689.

By Mr. Vogel, of Mr. Bishop's Observatory, South Villa, Regent's Park.

This great comet was invisible in Europe. It was seen at Pekin from December 10th to 21st, where the tail was from 10° to 12° above the horizon. At Ternate, the length of the tail on December 11th was $35°\frac{1}{2}$; on the 14th, 45°; on the 15th, 47°; and on the 22d, 60°; and was $2\frac{1}{2}^{h}$ in rising. It was last seen on December 24th, and was then greatly enfeebled by moonlight. It was observed by many Dutch ships in the vicinity of the equator. The observations upon which the orbit depends were taken by Father Richaud at Pondicherri, and by Béze and Comille at Malaca. On December 10th, at 4 o'clock A.M. (or December 9th, 10^{h} Greenwich mean time, Malaca being $102°\frac{1}{4}$ east of Greenwich), the comet was remarked to be in the intersection of two lines, one drawn from π *Centauri* of Bayer (4858 B.A.C.) and φ' *Lupi* of La Caille (5054 B.A.C.), the other passing through o and ξ *Lupi* of *Bayer (B.A.C.* 4924 and 5046), in the mouth of the *Wolf*, between

the tongue and the jaw; whence we have for the equinox of 1690, comet's longitude 239° 30′, latitude S. 16° 0′. Richaud also says the comet was in the mouth of the *Wolf*, between the tongue and the jaw; which, by Bayer's old atlas, would give, longitude 238° 40′, latitude S. 14° 30′; but this does not agree with the alignments. On December 14, according to all three observers, the comet was very near the small star υ (Bayer) *Lupi* (5139 ι *Lupi* in the B.A.C.) Richaud says "*tout proche*," and Béze, "*presque sur*:" hence the longitude comes out 238° 7′·6, latitude S. 22° 26′·9. On December 21, Richaud saw the comet 1° distant from the foot of the *Centaur* (α *Centauri*), certainly north of the star; since, on the 23d, it was still seen near the same: the assumed position is longitude 235° 5′, latitude S. 42° 0′. Béze and Comille say the comet moved between the 15th and 19th in a right line along the back of the *Wolf* towards α *Centauri*. The orbit which I have calculated upon these places gives, for the middle observation, errors of — 0′·6 in longitude and + 4′·5 in latitude; and is, therefore, very satisfactory. They are as follow:—

T	Nov. 29·200	
	° ′	
π	269 41·1	
☊	90 25·4	
i	59 4·5	
Log q	8·27720	Motion retrograde.

The supposed identity of the comet of 1689 with that of 1843 (suggested by Professor Peirce*) is not by any means admissible, though there was an outward similarity between the two comets. The elements exhibit the following large differences:—

	° ′
$\Delta\pi$	+ 7 7
Δ☊	−90 56
Δi	−23 25
Δq	−0·01337

nearly three times the least distance of the comet of 1843.

The following is a tabular view of the results given by the various orbits for this comet, as compared with the positions above given, the first two of which are not liable to more than 15′ error:—

	Dec. 10. l	Dec. 10. b	Dec. 14. l	Dec. 14. b	Dec. 21. l	Dec. 21. b
	° ′	° ′	° ′	° ′	° ′	° ′
Observation	239 30	−16 0	238 8	−22 27	235 5	−42 0
Pingré	239 26	16 48	237 45	24 19	235 45	38 26
Peirce	239 18	13 8	237 36	21 10	235 15	39 11
Vogel	239 30	16 0	238 7	22 31	235 5	42 0
Comet 1843	239 48	−16 26	238 50	−25 10	236 56	−42 14

* Peirce's elements in Galle's Catalogue are for the equinox of 1843.

The differences between the calculated and observed places are as subjoined:—

	Dec. 10. Δl ° ′	Dec. 10. Δb ° ′	Dec. 14. $\Delta l'$ ° ′	Dec. 14. $\Delta b''$ ° ′	Dec. 21. $\Delta l'$ ° ′	Dec. 21. $\Delta b''$ ° ′
Pingré	−0 4	−0 48	−0 23	−1 52	+0 40	+3 34
Peirce	−0 12	+2 52	−0 32	+1 17	+0 10	+2 49
Vogel	0 0	0 0	−0 1	−0 4	0 0	0 0
1843	+0 18	−0 26	+0 42	−2 43	+1 51	−0 14

The sums of the squares of these errors are,—

Pingré	62770
Peirce	65343
1843	41850
Vogel	17

The elements assumed for the comet of 1843 are those calculated by M. Valz of Marseille.

NEW NEBULA.

In April last Mr. Hind remarked a nebulous object in *Ophiuchus* near Lalande 33076, which does not occur in any of the catalogues of nebulæ hitherto consulted. Its mean place for the beginning of 1852 is

R.A. $17^h\ 56^m\ 15^s$ N.P.D. $90°\ 17'{\cdot}8$

It is very small and rather faint, perhaps 1′ in diameter, and is preceded a few seconds by a very minute hazy-looking star.

Micrometrical Measures of γ Virginis. By Isaac Fletcher, Esq., Tarn Bank.

	Position. ° ′	Obs.	Wt.	Power.	Distance. ″	Obs.	Wt.	Power.	Epoch.	
	174 23	8	2	300	3·227	8	2	300	1852·416	
	175 26	8	3	300	3·075	8	3	300	·424	
	175 39	8	3	300	3·151	8	3	300	·427	
	175 29	8	2	300	3·157	8	3	300	·427	
	175 57	8	2	230	3·166	8	2	230	·430	
Mean	175 24	40	12	...	3·149	40	13	...	1852·425	Result.

The observations are made with an achromatic equatoreal, of 6 feet focus, driven by clock-work.

The weights are assigned on the principle adopted by Sir John Herschel, in *reducing his measures* at the Cape.

Occultation of the Double Star 29 Aquarii observed by Mr. Snow at Ashurst. Latitude 51° 15′ 58″ N.; Longitude 1^m 10^s W.

	h m s		
1852 Sept. 4	23 32 38·4	Ashurst Sid. Time, Disappearance of 1st Star	
	23 32 41·4	— — — —	2d —

Five-foot equatoreal, power 170.

The disappearance took place at the dark limb. Probably the disappearance of the 1st star occurred 2^s earlier.

Note respecting the Pink Projections from the Sun's Disc observed during the Total Solar Eclipse observed in 1851. By C. Babbage, Esq.

On reading the accounts of the observations of the solar eclipse of 1852 in the *Notices of the Astronomical Society* for January, I could not but regret the shortness of the time, about $3\frac{1}{2}$ minutes, during which those interesting and important pink excrescences could be observed.

It occurred to me that it might not be impossible to render them visible at other times and under ordinary circumstances. I am induced to throw out the following suggestions, with the hope that they may fall into the hands of those who may possess instruments and leisure to make trial of the plans.

1st. I had on several occasions used small pieces of thin sheet metal placed in the focus of the object-glass of a telescope, for the purpose of covering a portion of the field, and thus obscuring the light of the moon, a planet, or a large star, in order to observe more clearly small stars or satellites in their immediate neighbourhood.

I had also, in making some experiments in order to ascertain the cause of the apparent projections of certain stars upon and within the moon's disc, produced a series of artificial occultations of the sun's light reflected from a thermometer bulb placed at the end of my garden. This was accomplished by causing a circle of sheet iron, whose circumference was cut into a series of equi-distant notches and placed immediately before the artificial star, to revolve by clock-work at the sun's rate at which the moon passes over the star.

It therefore immediately struck me, that by placing a disc of the same magnitude as the sun's image in the focus of a telescope mounted equatoreally, and moving by clock-work, a continual and apparently total eclipse of the sun might be produced. If all light were carefully excluded, it seems not improbable that the pink projections would, under these circumstances, become perceptible.

2d. In case this plan should not succeed, I proposed to use the same means in the focus of the object-glass and to project the sun's

image in a darkened chamber upon photographic paper or on silver. The direct rays of the sun being cut off, it is possible that the pink projections may have sufficient power to act on the prepared materials presented to them, and we might thus obtain solar pictures of these appendages.

Even if success should not attend either of these methods, the preparations made for the latter plan might furnish us with a highly interesting series of representations of the solar spots.

The connexion of these pink prominences with a species of volcanic action connected with the solar spots seems probable from the observations recorded. The fact that one of these pink clouds was entirely dissevered from the sun's limb may be accounted for by supposing it to have arisen from a spot on the farther side of the sun. Those who have observed the dense lofty column of smoke arising in a clear calm day to great heights above a crater, have also occasionally observed the top of the column of smoke, on reaching a gentle current of air, pass on horizontally to great distances. Such a horizontal column, seen endways from a point at a great distance from our planet, might appear to be entirely disconnected from it by any continuous line of smoke.*

Dorset Street, Manchester Square, 5 June, 1852.

Extract of a Letter from Mr. Maclear, dated Aug. 1, 1852.

"Mann is not over-strong. As for myself, though I show the marks of time, I never was in better health; viz. I have neither pains nor aches, nor any thing, save pained eyes from a very free use of them.

"My seven transit wires are now *on* the micrometer frame.

"I had remarked that the variations in the error of collimation were more changeable on the whole than the variations of the micrometer readings, viz. if the variations of collimation error be applied to the readings for coincidence of a micrometer wire with a fixed wire, the readings are nearly constant.

"It appears that when the micrometer screw is kept in position by a spring, small variations in the elasticity of the spring have no effect on the position of the screw so long as the residual elasticity is sufficiently strong for the work.

* Some months before the date of this note, Mr. Upton mentioned to me a plan for making the red prominences generally visible. The sun's image having been admitted into a darkened room, was to pass through an aperture in a white surface, the aperture being just equal to the image. The light after passing was to be afterwards absorbed in a box lined with black cloth. If the light could be sufficiently destroyed, it was expected that the red prominences might be seen on the rim of the aperture. Oddly enough, Mr. Upton had understood that the idea of the foregoing experiment originated with me, which it certainly did not, *nor do I know* the proposer. I mention this to prevent any misunderstanding. —*R. Sheepshanks.*

"The seven wires are $9^s \cdot 2$ apart at the equator, but they might be 7^s, nay 5^s, for an expert observer.

"The instrument is reversed every third day in fine weather for the reading for the line of collimation when the middle wire is in that line. Then, adding the correction for diurnal aberration, and for the distance of the middle wire from the mean of the seven, we obtain an imaginary wire which is driven into the line of collimation by means of the register head, and this is the *set* for observation.

"The next reversion shows if there is any residual error of collimation to apply. My books prove the advantage of the plan, and what is of some value besides, I have shaken off a portion of the calculations for errors of position. Why not use a micrometer for right ascensions as well as polar distances, if you have the means for verification or constant check? I am observing the whole of the southern stars of the B.A.C. in right ascension and polar distance. About 600 or 650 are not yet observed.

"A capital series of polar distances for another determination of the parallax of *α Centauri* are ready for computation.

"The relative positions of the components for July 25, 1852, are

Angle of Position ...	$262^\circ \cdot 77$
Distance	$5'' \cdot 03$

In January 1870 the angle and distance were respectively $246^\circ 0$ and $7'' \cdot 15$.

Extract of a Letter from Mr. Maclear, dated August 23, 1852.

"I have just received Stratford's ephemeris of Biela's Comet. The sky was clouded last night. I am now well armed for these visitors.

"Another batch of about 40 B.A.C. discrepancies are reduced, but not in shape. I will try to get them ready for the return mail; otherwise by the following. Some of these are not explicable by the plan hitherto offered. Therefore such should be closely watched.

"I expect that the *whole* of the southern stars of the B.A.C. will have been observed by the 31st of December, in right ascension and polar distance.

"An unceasing series of observations in right ascension has been taken of the close circumpolars since the 24th of May. On that day *τ Octantis* was observable at consecutive transits. Their season will end with *σ Octantis* in September. Thus good meridian marks are in progress of *erection* for the transit circle. Special tables can be calculated for one of the 10th mag. only about 9′ from the pole; with bright wire illumination this object will be useful. B.A.C. 7020 and *σ Octantis* are our best polars for micrometer transits. These admit of great precision and great despatch."

Mr. W. Gray states that "on Easter Monday, the 12th of April, I saw, at Scarborough, immediately after sunset, a red pillar above the sun's place, which I estimated at about 18 degrees in height. I noted it for about ten minutes, when I was obliged to leave the spot."

Extract of a Letter from Capt. Shea.

"I send you, for the inspection of the Royal Astronomical Society, a drawing representing the column of light seen by me for twenty minutes, immediately after sunset on the 8th of April, 1852. It did not appear to be a ray from the sun, as the sun set at the extreme left hand of the drawing.

"The phenomenon was observed from the Old Steine, Brighton, No. 8."

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NEW PLANET (*Lutetia*)

Discovered at Paris by M. Hermann Goldschmidt.

1852.	Paris M.T. h m	R.A. h m s	Decl. ° ′
Nov. 15	10 0	2 41 0	+ 12 34
16	11 45	2 40 5	12 32
17	10 30	2 39 55	+ 12 30

NEW PLANET (*Calliope*)

Discovered at Mr. Bishop's Observatory, by Mr. Hind.

1852.	Green. M.T. h m s	App. R.A. h m s	N.P.D. ° ′ ″
Nov. 16	12 32 0	5 13 37·5	65 30 7
17	11 51 52	5 12 49·38	65 26 44·5
18	8 46 30	5 12 5·51	65 22 33·2

MASSILIA.

Hamburg. (M. C. Rümker.)

1852.	Hamburg M.T. h m s	R.A. ° ′ ″	L. Fact. Parx.	Decl. ° ′ ″	L. Fact. Parx.	Comps.	Compd Star.
Oct. 26	8 32 33·8	355 53 76·8	9·1069 *n*	−1 26 56·7	9·9133	8	*i k*
	9 22 7·6	55·7		62·2	9·9134		Mer. Cir.
Nov. 6	8 7 31·3	355 10 46·4	8·8600 *n*	1 50 21·9	9·9154	4	*i*
	8 36 0·2	41·2		15·6	9·9154		Mer. Cir.
12	9 35 8·6	355 9 34·5	9·3236	1 53 14·8	9·9152	8	*i k*
13	8 8 28·5	10 38::		52 53·3	9·9157		Mer. Cir.
15	10 28 9·6	15 9·3	9·5527	51 59·8	9·9136	13	*i k*
19	6 37 8·7	27 56·4	9·2490 *n*	47 56·8	9·9142	6	*i k*
23	7 11 23·1	48 0·6	8·7211 *n*	40 22·0	9·9145	11	*i k*
24	5 56 4·0	355 53 39·8	9·3671 *n*	−1 38 29·9	9·9137	5	*i k*

Mean Places of Compared Stars for Jan. 0, 1852.

	R.A. h m s	Decl. ° ′ ″
i	23 40 7·00	−1 34 58·9
k	23 40 36·90	−1 35 45·3

FORTUNA.

DURHAM. Fraunhofer Equatoreal. (Mr. W. Ellis.)

1852.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	No. of Comps. of R.A.	N.P.D.	Set.
Aug. 29	12 19 55·9	22 16 17·24	+7·715	98 11 16·8	−9·9476	6	3	1
30	9 49 43·9	15 30·63	−8·273	16 18·2	9·9433	8	4	2
	11 42 9·9	26·48	−6·602	44·3	9·9484	6	3	3
31	12 5 2·8	14 31·77	+7·627	22 29·4	9·9485	18	6	4
Sept. 1	13 1 0·9	13 37·67	8·156	28 20·4	9·9462	18	6	5
	13 43 26·6	36·04	+8·318	32·2	9·9427	6	2	6
2	10 38 43·8	12 51·02	−7·939	33 27·3	9·9484	18	6	7
3	13 16 58·9	11 53·59	+8·262	98 39 37·3	9·9449	30	6	8
	13 55 40·4	51·86	8·378	44·4	9·9410	18	6	9
	14 34 49·3	50·55	8·459	55·2	9·9360	18	6	10
7	11 44 50·6	8 36·66	7·814	99 1 17·5	9·9506	18	6	11
	12 48 25·4	35·21	8·227	35·0	9·9469	12	3	12
9	13 43 51·0	22 6 57·78	+8·417	99 12 24·2	−9·9403	4	2	13

The observations were made with the wire micrometer, and are corrected for refraction. The corrections for parallax are represented by p and q as usual; P being the Equat. Hor. Parallax.

Assumed *Mean* Places of the Stars of Comparison, 1852, January 1.

Star.	R.A. h m s	N.P.D. ° ′ ″	Set.	Authority.
36 Aquarii	22 1 37·16	98 54 41·8	11	Greenwich 12-year Catalogue.
Weisse XXII, 143	7 45·53	99 7 50·1	12, 13	Weisse's Catalogue.
θ Aquarii	9 1·19	98 31 6·2	6, 10	Greenwich 12-year Catalogue.
Weisse XXII, 223	11 21·16	32 12·7	9	Mean of Weisse's and Rümker's Catalogue.
ϱ Aquarii	12 24·49	33 43·7	4, 5, 7, 8	Greenwich 12-year Catalogue.
Weisse XXII, 397	22 18 48·27	98 7 38·0	1, 2, 3	Weisse's Catalogue.

Remarks.

Set 1, 6, 12. The observations interrupted by clouds.
— 2, 3. Cloudy, and very windy; at times putting the telescope in vibration.
— 13. Observed during a short break in the clouds on a cloudy and windy night.

OXFORD. Ring Micrometer.

1852.	Greenwich M.T. h m s	497ˢ·8 × Δ. m s	App. R.A. h m s	Par. in R.A. s	App. N.P.D. ° ′ ″	Par. in N.P.D. ″	Comps.
Sept. 1	12 48 15·7	− 9 46·3	22 13 38·23	+0·10	98 28 13·3	−6·3	9 with *h*
2	11 51 52·1	9 46·8	12 48·29	0·03	33 39·0	6·3	15 with *h*
3	13 20 43·1	9 47·2	11 53·45	0·15	98 39 31·5	6·2	10 with *h*
10	12 3 17·3	9 52·8	22 6 15·59	0·09	99 17 9·8	6·2	14 with *i*
Oct. 2	11 12 12·2	10 44·5	21 55 37·59	0·14	100 41 46·6	5·8	4 with *k* & *l*
5	11 25 1·3	−10 55·1	21 55 17·19	+0·16	100 47 30·6	−5·6	12 with *l*

The above observations are corrected for refraction; they were made by Mr. *Norman Pogson.*

Mean Places of the Stars of Comparison for 1852·0.

	R.A. h m s	N.P.D. ° ′ ″
h = B.A.C. 7784 (*ρ* Aquarii)	22 12 24·55	98 33 41·2
i = Weisse XXII, 143	22 7 45·59	99 7 43·3
k = Weisse XXI, 1333 = 43044 Lalande	21 57 41·94	100 36 48·1
l = 42928 Lalande	21 53 56·86	100 35 8·6

Haverhill. Equatoreal. (Mr. W. W. Boreham.)

1852.	Greenwich M.T. h m s	R.A. h m s	Log P^s.	N.P.D. ° ′ ″	Log P″.	Obs.	Star.
Aug. 26	10 11 25·5	22 19 1·04	−9·1996	97 53 50·9	−0·8654	10	*a*
27	9 37 53·3	18 9·90	9·2936	97 59 16·7	0·8630	10	*b*
31	9 6 10	14 39·53	9·3213	98 21 39·7	0·8632	7	*c*
Sept. 1	10 11 58·5	13 43·82	9·0567	98 27 36·3	0·8698	10	*c*
3	9 12 36·5	12 2·55	9·2711	98 38 38·0	0·8662	10	*c*
8	9 52 35·5	7 51·64	8·9907	99 6 17·6	0·8731	10	*d*
9	8 55 36·5	7 6·32	9·2527	12 17·8	0·8692	8	*e*
11	10 38 21	5 32·41	7·9964	23 2·3	0·8762	7	*e*
12	10 0 46	4 49·93	8·7906	28 2·8	0·8758	5	*e*
13	9 47 36	22 4 7·81	−8·8776	99 32 57·5	−0·8758	5	*e*

$\frac{P}{\Delta}$ = The parallax in seconds of time in R.A. and in seconds of arc in N.P.D. where Δ is the distance of the planet from the earth.

The observations are corrected for refraction.

Mean Places for 1852·0 of the Stars of Comparison.

		R.A. h m s	N.P.D. ° ′ ″
a	Weisse xxii, 397	22 18 48·27	98 7 38·1
b	B.A.C. 7804	15 46·36	97 56 25·0
c	— 7784	12 24·55	98 33 41·0
d	— 7773	9 1·07	98 31 5·3
e	— 7774	22 9 3·57	99 47 33·6

Hamburg. (M. C. Rümker.)

1852.	Hamburg M.T. h m s	R.A. ° ′ ″	L. Fact. Par^x.	Decl. ° ′ ″	L. Fact. Par^x.	Comp.	Comp^d Stars.
Oct. 24	7 46 30·1	329 57 20·2		−10 47 45·8	9·9549		Mer. Cir.
26	7 39 46·1	330 14 20·0		10 45 30·2	9·9548		Mer. Cir.
Nov. 6	6 23 35·7	332 15 8·0	9·0319*n*	10 13 23·0	9·9520	5	*g*
12	8 58 19·0	333 41 26·5	9·5164	−9 47 37·0	9·9432	6	*h*

Apparent Places of Computed Stars.

	R.A. h m s	Decl. ° ′ ″
g	22 7 46·03	−10 20 49·3
h	22 12 46·45	− 9 47 16·9

EUNOMIA.

HAMBURG. (M. C. Rümker.)

1852.	Hamburg M.T. h m s	R.A. ° ′ ″	L. Fact. Parx.	Decl. ° ′ ″	L. Fact. Parx.	Comps.	Compd Star.
Nov. 6	11 10 8·5	80 4 35·0	9·7335 *n*	+37 30 50·1	9·5884	13	*pq*
12	10 14 4·0	79 5 42·0	9·7787 *n*	37 23 47·9	9·6271	4	*rs*
13	9 11 23·3	78 54 37·7	9·8409 *n*	37 22 6·6	9·7023	13	*t*
15	11 48 12·5	78 28 22·5	9·5194	37 17 23·3	9·5012	15	*u*
19	7 53 13·7	77 35 38·7	9·8659 *n*	+37 6 12·3	9·7644	12	*vwz*

Apparent Places of Compared Stars for Date of Comparison.

	R.A. h m s	Decl. ° ′ ″		R.A. h m s	Decl. ° ′ ″
p	5 20 5·51	+37 31 18·9	*u*	5 14 39·55	+37 14 31·3
q	20 45·41	41 27·4	*v*	9 7·56	8 50·5
r	14 39·46	14 30·8	*w*	9 16·18	7 41·7
s	14 57·39	21 40·9	*z*	5 10 43·22	+37 16 52·7
t	5 14 57·40	+37 21 41·2			

HYGEIA.

DURHAM. Fraunhofer Equatoreal. (Mr. W. Ellis.)

1852.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	No. of Comps. of R.A.	N.P.D.	Set.
Oct. 23	11 57 57·2	4 49 4·92	−8·456	64 2 46·77	−9·7345	18	6	1
	12 41 56·6	3·71	8·341	48·48	9·7110	18	6	2
24	9 42 21·3	4 48 42·71	−8·616	64 3 9·72	−9·8225	15	6	3
	15 34 7·8	36·66	+7·998	14·47	9·6860	12	4	4
	15 52 21·9	36·16	+8·123	......	...	12	...	5
25	10 58 58·6	4 48 15·89	−8·542	64 3 40·27	−9·7666	18	6	6

The observations were made as usual with the wire micrometer, and are corrected for refraction. The corrections for parallax in time and arc, which are to be applied to the R.A. and N.P.D., are represented by p and q. P = Equat. Hor. Parallax.

Assumed *Mean* Places of the Stars of Comparison, 1852, January 1.

Star.	R.A. h m s	N.P.D. ° ′ ″	Set.
No. 109 of Bessel's Zone 396	4 49 10·52	64 8 42·81	2, 3, 5, 6
No. 110 — — —	4 50 30·73	63 58 39·81	1, 4

Set 3. Interrupted by clouds.
— 5. R.A. comparisons only taken; the nearly vertical position of the telescope so near the meridian renders the observations rather difficult.

The above are all the observations of *Hygeia* obtained in the month of October; they are reduced at present, provisionally, using the places of the stars as given by Bessel's Zone Observations. A more correct reduction will hereafter be made, Professor Challis having kindly undertaken to reobserve the two stars.

IRENE.

Durham. Fraunhofer Equatoreal. (Mr. W. Ellis.)

1852.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	No. of Comps of R.A.	N.P.D.	Set.
Sept. 11	13 18 54·2	23 10 10·07	+8·181	109 45 23·1	−9·9762	12	4	1
13	12 0 59·4	8 28·64	7·514	109 54 40·3	9·9827	18	6	2
16	13 8 36·0	5 51·62	8·243	110 7 47·3	9·9748	18	6	3
17	12 5 6·1	23 5 3·40	+7·873	110 11 35·9	−9·9820	18	6	4

The observations were made with the wire micrometer, and they are corrected for refraction. The corrections for parallax are represented by p and q as usual; P being the Equat. Hor. Parallax.

Assumed *Mean* Places of the Stars of Comparison, 1852, January 1.

Star.	R.A. h m s	N.P.D. ° ′ ″	Set.	Authority.
Anonymous, 10th mag.	23 5 7·69	110 3 53·6	3, 4	Equat. comps. with Lal. 45800.
Lalande 45610	10 41·14	109 38 59·0	1	Mean of Lalande and 54 of Arg. Zone 262.
— 45800	23 15 57·52	109 55 12·3	2	Mean of Lal. and 61 of Arg. Z. 262.

Remarks.

Set 1. A violent wind, the clock was with great difficulty heard.
— 3 and 4. The assumed place of the star is from six comparisons of R.A. and two comparisons of N.P.D. with Lalande 45800.
The planet was very faint on each night, but appeared brightest on September 17.

MELPOMENE.

Oxford. Meridian. (Mr. Johnson.)

	Greenwich M.T. h m s	497s·8 × Δ. m s	Appt R.A. h m s	Appt N.P.D. ° ′ ″	Parx in N.P.D. ″
July 7	11 0 28·4	−10 20·5	17 59 39·00	99 2 4·4	−6·0
21	9 53 32·4	−10 33·3	17 47 43·94	100 20 5·4	−5·9

With the Ring Micrometer.

1852.	Greenwich M.T. h m s	497s·8 × Δ. m s	App. R.A. h m s	Par. in R.A. s	App. N.P.D. ° ′ ″	Par. in N.P.D. ″	Comps.
July 3	12 40 55·5	−10 20·5	18 3 36·28	+0·10	98 45 9·0	−5·9	9 with *a*
7	12 43 30·7	10 20·5	17 59 34·86	0·13	99 2 24·5	5·9	12 with *b*
8	12 20 11·9	10 20·8	58 37·20	0·10	7 5·5	5·9	11 with *b* & *c*
9	13 6 1·4	10 21·2	57 37·62	0·16	12 12·8	5·9	7 with *b* & *c*
12	12 5 3·8	10 22·9	54 52·65	0·11	27 25·5	5·9	16 with *c* & *d*
15	12 3 51·6	10 25·5	52 16·05	0·12	44 4·3	5·9	12 with *e*
17	12 32 16·7	10 27·6	50 37·23	0·16	99 55 56·3	5·8	16 with *e*
21	12 26 27·8	10 33·3	47 39·94	0·18	100 20 43·9	5·8	6 with *f*
22	12 8 26·4	10 34·7	47 0·10	0·16	27 5·3	5·8	7 with *f*
23	12 6 31·3	10 36·5	46 21·62	0·16	33 42·2	5·8	13 with *f*
24	12 32 26·4	−10 38·3	17 45 43·51	+0·19	100 40 29·3	−5·7	10 with g

The adopted *Mean* Places of the Comparison Stars for 1852·0 are as follows:—

	R.A. h m s	N.P.D. ° ′ ″
a = Weisse XVIII, 61 = 33403 Lalande	18 3 56·22	98 45 32·4
b = Weisse XVII, 1260	17 59 26·89	99 11 28·5
c = Weisse XVII, 1212	17 57 37·30	99 16 6·4
d = Weisse XVII, 1169	17 55 47·05	99 15 1·9
e = B.A.C. 6078 (ν Ophiuchi)	17 50 52·88	99 45 2·4
f = Weisse XVII, 906 = 32665 Lalande	17 45 1·12	100 19 47·6
g = B.A.C. 6049	17 44 50·19	100 51 35·6

The observations are corrected for refraction. Those with the ring micrometer are made by Mr. Norman Pogson.

DURHAM. Fraunhofer Equatoreal. (Mr. W. Ellis.)

1852.	Green. M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	No. of Comps. of R.A.	No. of Comps. of N.P.D.	Set.
July 3	13 14 56·8	18 3 34·58	+8·268	......	...	4	...	1
4	12 54 15·9	2 34·73	8·209	......	...	9	...	2
5	12 42 3·2	18 1 34·53	8·177	......	...	9	...	3
8	12 6 32·6	17 58 37·58	8·070	......	...	10	...	4
10	12 20 22·1	56 42·47	8·190	99 16 58·7	−9·9485	30	10	5
11	11 27 41·3	55 48·74	7·885	21 58·1	9·9516	18	6	6
12	11 29 6·1	54 53·88	7·942	27 15·0	9·9516	18	6	7
	13 42 26·1	49·32	8·452	27 54·1	9·9383	6	2	8
14	11 34 52·9	53 7·94	8·053	38 18·6	9·9516	4	2	9
17	11 58 43·5	50 37·80	8·241	55 46·3	9·9496	6	6	10
	12 42 8·6	36·28	8·375	99 55 58·6	9·9447	6	6	11
18	11 37 52·5	49 52·08	8·173	100 1 48·5	9·9513	18	6	12
19	10 54 24·6	49 8·19	7·932	7 46·0	9·9541	18	6	13
22	11 45 57·0	47 0·74	8·279	27 5·7	9·9501	18	6	14
23	11 0 43·3	46 23·27	8·097	33 26·4	9·9536	12	4	15
24	10 59 43·9	45 46·30	8·122	100 40 7·9	9·9541	18	6	16
Aug. 3	11 56 10·8	41 19·92	8·443	101 50 44·8	9·9445	15	5	17
4	10 50 48·5	41 4·69	8·288	101 57 47·5	9·9542	12	4	18
5	10 45 33·9	40 51·21	8·284	102 5 4·4	9·9547	18	6	19
7	10 13 8·7	40 30·13	8·190	19 44·0	9·9580	3	1	20
8	11 36 40·1	40 21·83	8·447	27 35·7	9·9455	18	6	21
9	10 30 59·3	40 16·57	8·291	102 34 42·9	9·9558	20	10	22
31	9 39 20·4	46 47·93	8·379	105 18 9·9	9·9574	12	6	23
Sept. 3	9 13 52·4	48 52·35	8·336	105 39 20·1	9·9610	6	2	24
10	9 3 49·4	54 47·67	8·370	106 26 46·9	9·9604	10	5	25
11	9 16 29·8	55 45·70	8·409	33 18·7	9·9573	8	4	26
13	8 50 15·8	17 57 45·14	8·359	106 46 1·5	9·9619	18	6	27
17	9 30 8·4	18 2 5·71	+8·473	(107 11 6·1)	−9·9507	18	3	28

The observations are corrected for refraction.

The corrections for parallax in time and arc which are to be applied to the

R.A. and N.P.D. are represented by p and q respectively. P = Equatoreal Horizontal Parallax.

On July 3, 4, 5, and 8, the observations were made with the ring micrometer. As it was found that the N.P.D.'s deduced from these observations were not at all satisfactory, they have been omitted from the above table; the results for R.A. however, appeared to be worth retaining. From July 10 the observations were made with the wire micrometer.

Assumed *Mean* Places of the Stars of Comparison, 1852, January 1.

Star.	R.A. h m s	N.P.D. ° ′ ″	Set.	Authority.
Lalande 32525	17 41 36·82	102 33 29·28	22	Equat. comps. with Weisse XVII. 887, and *o* Serpentis.
Weisse XVII, 834	42 6·52	6 45·65	18, 19	Weisse's Catalogue.
— XVII, 887	44 39·66	102 21 48·61	20, 21	— —
B.A.C. 6049	44 50·26	100 51 34·20	16	Mean of B.A. and Weisse's Cat.
Weisse XVII, 906	45 0·85	100 19 52·23	14, 15	Weisse's Catalogue.
B.A.C. 6065	47 48·23	105 46 57·13	24	B.A. Catalogue.
Weisse XVII, 966	47 51·19	105 9 12·08	23	Weisse's Catalogue.
— XVII, 980	48 16·70	100 9 38·07	12, 13	— —
— XVII, 1029	50 24·10	101 51 15·81	17	— —
ν Ophiuchi	50 52·83	99 45 3·48	9, 10, 11	Greenwich 12-year Catalogue.
Weisse XVII, 1169	55 47·06	99 15 1·75	7	Weisse's Catalogue.
— XVII, 1212	57 37·31	99 16 6·23	4, 5, 6	— —
Lalande 33178	58 39·31	106 39 59·00	27	Mean of Lalande and No. 5 of Arg. Zone 230.
No. 37 of Arg. Zone 218	59 13·44	107 10 8·95	28	Mean of No. 37 of Arg. Zone 218 and No. 2 of Zone 225.
Lalande 33222	17 59 55·56	106 25 53·06	25, 26	Mean of Lal. No. 3 of Arg. Zone 225 and No. 8 of Zone 230.
Weisse XVIII, 7	18 1 36·58	......	2, 3	Weisse's Catalogue
— XVIII, 51	3 38·83	99 34 28·62	8	— —
— XVIII, 61	18 3 56·16	......	1	— —

Remarks.

Set 1, 9, 13, 18, 21, and 24. The observations were unfavourably taken on account of clouds.

— 8. No more comparisons could be taken with this star, as the planet could not be seen any longer.

— 10 and 11. The star very inconveniently situated for observation.

— 15. Observed with difficulty on account of clouds; the wind also continually put the telescope into a state of vibration. No star was to be had nearer in N.P.D. to the planet.

— 16. No star was to be had nearer in N.P.D. to the planet.

— 17. Fine night; the planet was very near to a small star, causing some uncertainty in the observation.

— 20. One set of comparisons only, obtained between clouds.

— 22. Lalande's place of the star is not taken; the assumed place depends entirely on equatoreal comparisons with Weisse's Bessel XVII, 887 and *o Serpentis*, being the mean of six comparisons of R.A. and two comparisons of N.P.D. with each star.

— 23. Fine night, but the wind troublesome.

— 26. High wind; the hearing tube used.

— 27. Foggy; the planet extremely faint.

— 28. The N.P.D. measures are bad, the planet was so faint; the resulting N.P.D. must only be considered as approximate.

WESTPHAL'S COMET. II. 1852.

HAMBURG. (M. C. Rümker.)

1852.	Hamburg M.T. h m s	R.A. ° ′ ″	L. Fact. Par^x.	Decl. ° ′ ″	L. Fact. Par^x.	Comps.	Comp Stars
Nov. 4	9 31 47·5	210 23 29	9·8519	+70 46 31·0	9·8924	2	*a b c*
6	9 46 12·3	210 38 37	9·7293	+70 7 15·7	9·9059	3	*d e f*

Apparent Places of Compared Stars.

	R.A. h m s	Decl. ° ′ ″		R.A. h m s	Decl. ° ′ ″
a	13 59 6·06	+71 2 41·5	*d*	14 6 36·40	+70 17 9·4
b	14 0 28·19	70 59 36·2	*e*	14 7 36·24	70 3 8·3
c	14 0 42·41	+70 43 58·8	*f*	14 7 16·67	+70 7 31·9

In vol. xii. p. 93, Mr. Edward Hill is mentioned "as the inventor of the envelope machine:" the machine referred to being that which was exhibited last year by Messrs. Thomas De la Rue and Co. The Editor is informed by MM. Edwin Hill and Warren De la Rue that this machine is their *joint* invention, and that they are *joint* patentees.

ERRATA

Vol. xi. page 52, line 5 from the bottom, *for* "inner axis," *read* "minor axis."

Vol. xii. page 50, line 11, *read* its north end highest, about 1′ high. The other two were, &c.

— — 61, line 19, *read* lat. 57° 42′ 58″ N., long. $0^h\ 47^m\ 45^s{\cdot}3$ E.

— — 62, line 25, *for* group of spots 1′, *read* $1\frac{1}{2}'$.

— — —, lines 27, 28, 29, *for* $3^h\ 8^m$, *read* $3^h\ 58^m$.

In the early copies, vol. xii. No. 3 (*Solar Eclipse*),

Page 43, line 19, *for* Colonel Silverstopfe, *read* Silverstolpe.

— 45, last line, *for* 70°, *read* 45°.

— 46, line 1, *for* 100°, *read* 80°.

— — — 2, *for* 145°, *read* 110°.

— 47, — 34, *for* RINGERIGEL, *read* RINGERIDET.

— 49, — 29, 31, *for* JUNE, *read* TUNE.

— 64, — 42, *for* $3^h\ 56^m\ 54^s{\cdot}9$, *read* $3^h\ 55^m\ 54^s{\cdot}9$.

— 66, — 18, *for* RAVELSBERG, *read* RÆVELSBERG.

— 67, 2d line from bottom, *for* 22 inches, *read* 20 inches.

— 72, line 30, *for* Colonel Silverstopfe, *read* Silverstolpe.

In plate, *for* 11, *read* 14.

These last-mentioned errata were corrected in the copies distinguished by an asterisk affixed to the Number, No. 3.*

Vol. xii. page 152, line 4 from the bottom, *for* 18″·61, *read* 28″·61.

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INDEX.

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APPENDIX III.

CONTAINING

Presents received during the Session 1851–52.

Académie des Sciences, Mémoires présentés par divers Savants, tome treizième, 4to. *Paris*, 1852	L'Académie des Sciences.
———————, Comptes rendus hebdomadaires, 4to., vols. xxxiii., 1851 ; xxxiv., 1852, 4to. *Paris*	———
American Association for the Advancement of Science. Fourth Meeting, held at New Haven, Conn., August 1850, 8vo. *Washington*, 1851	The Smithsonian Institution.
——— Philosophical Society, Proceedings, vol. v., No. 46, 8vo. *Washington*, 1851	The Society.
Annales Hydrographiques, tomes iv. v., 8vo. *Paris*, 1850–1	Le Dépôt Général de la Marine.
Annuaire des Marées des Côtes de France pour 1852, 12mo. *Paris*, 1851	———
Architect, The, Nos. 187–194, and vol. xiv. part 2, folio. *London*, 1851–52	The Editor.
Asiatic Society (Royal), Journal of the, vol. xiv., 8vo. *London*, 1852	The Society.
Assurance Magazine, vol. i., vol. ii. parts 5–7, 8vo. *London*, 1851–52	The Institute of Actuaries.
Astronomical Journal, various Nos., 4to. *Cambridge, U.S.*, 1851–52	The Editor.
Astronomische Nachrichten, Nos. 761–809, 4to. *Altona*, 1851–52	The Editors.
————————, General Register der Bände 1 bis xx., von G. A. Jahn, 4to. *Hamburg*, 1851	Rev. R. Sheepshanks.
Babbage, Charles, The Ninth Bridgewater Treatise, a Fragment, 2d edition, 8vo. *London*, 1838	The Author.

The Author. Babbage, Charles, Notes respecting Lighthouses, 8vo. *London.*

—— ——————, On the Influence of Signs in Mathematical Reasoning, 4to. *Cambridge*, 1826

—— ——————, Laws of Mechanical Notation, 4to.

—— ——————, The Eleventh Chapter of the History of the Royal Society, 8vo. *London*, 1848

—— ——————, The Exposition of 1851, or Views of the Industry, the Science, and the Government of England. 2d edition, with additions, 8vo. *London*, 1851

—— Bateman, Joseph, The Construction and Application of the Sliding Rule used by the Officers of Her Majesty's Revenue, 8vo. *London*, 1852

—— Beke, C. T., An Inquiry into M. Antoine d'Abbadie's Journey to Kaffa to discover the Source of the Nile. 2d edition, 8vo. *London*, 1851

—— ——————, A Summary of recent Nilotic Discovery, 8vo. *London*, 1851

—— ——————, On the Alluvia of Babylonia and Chaldæa, 8vo. *London*, 1851

The Academy. Berlin. Abhandlungen der Königlichen Akademie der Wissenschaften, 1849, 4to. *Berlin*, 1851

—— —— Monatsbericht der, July 1850 to June 1851, 8vo. *Berlin*, 1850–51

The Royal Academy of Sciences at Berlin. —— Astronomische Sternkarten, Zone xx. Uhr (Blatt 21), Zone i. Uhr (Blatt 2), Zone xi. Uhr (Blatt 12), folio. *Berlin*, 1849–52

The Author. Birt, W. R., The Sailor's Guide, or Short and Easy Rules for Vessels in Revolving Storms, sheet. *London*, 1852

Rev. R. Sheepshanks. Bohnenberger, J. G. F., Anleitung zur Geographischen Ortsbestimmung vorzüglich mittels des Spiegelsextanten neu bearbeitet von Dr. G. A. Jahn, 4to. *Göttingen*, 1852

The Hon. East India Company. Bombay. Observations made at the Magnetical and Meteorological Observatory of, in the year 1847; part 2, Meteorological Observations, 4to. *Bombay*, 1851

—— —— Magnetical and Meteorological Observations made at the Observatory of, in the year 1848, 4to. *Bombay*, 1851

British Association for the Advancement of Science, Report of the Twentieth Meeting at Edinburgh, 1850, 8vo. *London*, 1851	The British Association.
—— Meteorological Society, Report of the Council read at the first Annual General Meeting, May 27, 1851, 8vo. *London*, 1851	The British Meteorological Society.
Bureau des Longitudes, Annuaire pour l'an 1852, 18mo. *Paris*, 1851	Le Bureau des Longitudes.
Busch, Dr., Beobachtungen und Wahrnehmungen welche bei der totalen Sonnenfinsterniss am Juli 28, 1851, gemacht worden sind. 12mo. *Königsberg*, 1852	The Author.
Cagnoli, A., Notizie Astronomische del Professore Cavaliere, adattate all' uso comune; seconda Edizione accresciuta di Annotazioni dai Professori G. Bianchi, F. Carlini, A. Colla, Volume primo 12mo. *Parma*, 1851	Prof. Colla.
Cambridge Philosophical Society, Transactions, vol. ix., part 2, 4to. *Cambridge*, 1851	The Cambridge Phil. Society.
Carrington, R. C., An Account of the late Total Eclipse of the Sun on July 28, 1851, as observed at Lilla Edet, in Sweden, 8vo. *Durham*, 1851	The Author.
Cerquero, Don J. S., Esplicacion de las Tablas de Navegacion y Astronomia Nautica de Don José de Mendoza y Rios, primera tirada, 4to. *Madrid*, 1851	The Observatory of San Fernando.
Civil Engineers' Institution, Minutes of Proceedings, &c., Sessions 1849–50, 1850–51, 8vo. *London*, 1852	The Institution of Civil Engineers.
—— —— —— List of Members, 8vo. *London*, 1852	——
—— —— —— Premiums awarded, 1850, sheet *London*, 1851	——
Cocker's Arithmetic, edited by Geo. Fisher, 12mo. *London*, 1767	T.T. Wilkinson, Esq.
—— ——, edited by Isaac Jackson, 12mo. *Dublin*, 1769	——
Colla, A., Meteorologica. Fortissime perturbazioni Magnetiche ed Aurore Boreale osservati a Parma ne' Giorni, 23 e 24 Ottobre, 1827, 8vo.	The Author.
—— Astronomia. Ritorno della Cometa di Encke, sheet.	——
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The Author.	Colla, A., Annotazioni alle Notizie Astronomische del Cavaliere A. Cagnoli, vol. secondo, 12mo. (*See* Cagnoli). *Parma*, 1851
——	——— Sulle due Comete di D'Arrest e di Brorsen scoperte nel 1851, 8vo. *Rome*, 1851
——	——— Sulle due Comete scoperte nell' anno 1850 da Petersen e da Bond, e sul ritorno della cometa periodica di Faye scoperta nel 1843, 8vo. *Rome*, 1851
Father Secchi.	Collegio Romano, Memorie dell' Osservatorio dell' Universita Gregoriana, in anno 1850, 4to. *Rome*, 1851
A. De Morgan, Esq.	Companion to the Almanac for 1852, 8vo. *London*, 1852
The Author.	Conder, F. R., The Geognostic Pendulum, or an Inquiry into the Theory of the Pendulum Experiment, 8vo. *London*, 1851
——	Cooper, E. J., Catalogue of Stars near the Ecliptic, observed at Markree during the years 1848, 1849, and 1850, and whose places are supposed to be hitherto unpublished. Vol. i. containing 14,888 stars, 8vo. *Dublin*, 1851
——	Cull, Rd., Remarks on the Objects and Evidences of Ethnological Science, 8vo. *London*, 1851
——	Daussy, M., Tables des Positions Géographiques, 8vo. *Paris.*
——	De Morgan, A., On some Points of the Integral Calculus, 4to. *Cambridge*, 1851
——	———— On the Authorship of the Account of the Commercium Epistolicum, 8vo. *London*, 1852
The Academy at Dijon.	Dijon. Mémoires de l'Académie des Sciences, 1850, 8vo. *Dijon*, 1851
The Society.	Edinburgh Royal Society, Transactions of the, vol. xx. part 2, 4to. *Edinburgh*, 1851
——	————, Proceedings of the, vol. ii. Nos. 40, 41, 8vo. *Edinburgh*, 1851
The Royal Obervatory, Edinburgh.	————, Astronomical Observations made at the Royal Observatory by the late Thomas Henderson, reduced and edited by his successor, Chas. Piazzi Smyth, vol. x. for 1844–7, 4to. *Edinburgh*, 1852
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Gray, P., Remarks on a Problem in Life Contingencies, 8vo. *London*, 1750	The Institute of Actuaries.
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Le Dépôt Général de la Marine.	Montravel, Tardy de, Instructions nautiques pour naviguer sur les Côtes des Guyanes, 8vo. *Paris*, 1851
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———	———, Bulletin der ditto ditto, 1850, 4to. *Munich*, 1851
The Royal Observatory of Munich.	———, Beobachtungen der Meteorologischen Observatoriums auf dem Hohenpeissenberg von 1792–1852, von Dr. J. Lamont, 8vo. *Munich*, 1851
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The Museum of Practical Geology.	Museum of Practical Geology, Inaugural Discourse by Sir H. T. De la Beche, 8vo. *London*, 1851
The Academy of Sciences at Naples.	Naples. Rendiconto delle Adunanze e de' Lavori della Reale Accademia delle Scienze, No. 51, 4to. *Naples*, 1852
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Rev. R. Sheepshanks.	Olbers, W., Abhandlung über die leichteste und bequemste Methode die Bahn eines Cometen zu berechnen, von Dr. Wilhelm Olbers. New edition by J. F. Encke, 8vo. *Weimar*, 1847
B. Vulliamy, Esq.	Palace of Westminster. Copy of the Memorial presented to her Majesty's Commissioners of Works and Public Buildings, by the Clockmakers' Company of London, respecting the great Clock of the new Palace of Westminster, with the Answer, folio. *London*, 1852
Le Bureau des Longitudes.	Paris. Observations Astronomiques, faites à l'Observatoire de Paris, années 1837 à 1846, folio. *Paris, V. Y.*
The Author.	Parpart, A., Bericht an eine Königl. Preuss. Academie der Weissenschaften zu Berlin, über die auf der Sternwarte zu Storlus, während der Sonnenfinsterniss vom 28 Juli, 1851, angestelten Astron. und Meteor. Beobachtungen, 8vo. *Culm*, 1851

Perrey, A., Thèse de Mécanique soutenue devant la Faculté des Sciences de Dijon. Théorie du Mouvement d'un Corps solide autour d'un point fixe, 4to. *Dijon*, 1838	The Author.
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Pétersbourg, St., Mémoires de l'Académie Impériale des Sciences, tome iv. liv. 3, 4, 4to. *St. Pétersbourg*, 1850	The Academy.
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Pole, William, On the Strength and Deflection of Beams, with Applications to the Britannia and Conway Tubular Bridges, 8vo. *London*, 1850	The Author.
Plantamour, E., Résumé des Observations Thermométriques et Barométriques, faites à l'Observatoire de Genève et au Grand St. Bernard pendant les dix Années, 1841 à 1840; suivie de Tables Hypsométriques, calculées d'après la Formule de Bessel, 4to. *Geneva*, 1851	———
Playfair, Lyon, On the National Importance of studying abstract Science, with a view to the healthy progress of Society, 8vo. *London*, 1851	The Museum of Practical Geology.
Ramchundra. A Treatise on Maxima and Minima, solved by Algebra, by Ramchundra, Teacher of Science, Delhi College, 8vo. *Calcutta*, 1850	Capt. Bethune.
Raper, H. The Practice of Navigation and Nautical Astronomy, 4th edition, 8vo. *London*, 1852	The Author.
Registrar-General, Births, Deaths, and Marriages registered in the Metropolis. Annual Series, 1851–52.	The Registrar-General.
—————, Marriages, Births, and Deaths registered in the Divisions, Counties, and Districts of England, 8vo. *London*, 1851–52	———
—————, Summary of the London Returns of Mortality for the Twelve Years 1840-51, sheet. *London*, 1852	———

Tacon, Don J. J. Martinez de Espinosa y. Coleccion completa de Tablas para los usos de la Navegacion y Astronomia Nautica, par Don José de Mendoza y Rios. Edicion estereotipica, corregida y augmentada, dispuesta por. Primera tirada, 4to. *Madrid*, 1851

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—— ————, Vier und dreissigster Theil, Neuer Folge, vierzehnter Band, 4to. *Vienna*, 1851

—— ————, Meteorologische Beobachtungen an der Wiener Sternwarte in den Jahren, 1847–50, oblong folio *Vienna*, 1851

—— ————, Uebersicht der Meteorologische Beobachtungen in Jahren, 1847–50, oblong folio *Vienna*, 1851

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Maps, Charts, &c.

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Chart of the Discoveries in the Arctic Seas up to 1851. — Admiral Sir F. Beaufort.

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Six Charts. — The United States' Coast Survey.

Diagrams of the Solar Spots, 2 vols. — Rev. T. Chevallier.

Register Maps, indicating Conditions of the Atmosphere on the same day in several parts of Great Britain, from Observations collected at the Great Exhibition from August 8 to October 11 inclusive. *London*, 1851 — Dr. Lee.

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Miscellaneous Articles.

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A Drawing of the Planet Saturn, framed and glazed. — W. De La Rue, Esq.

Two Drawings, framed and glazed, of the Planet Mars at the Opposition in 1852. — ———

A Drawing, framed and glazed, of the Planet Mercury. — ———